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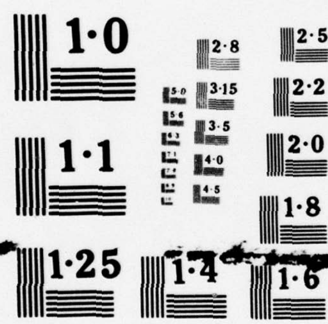
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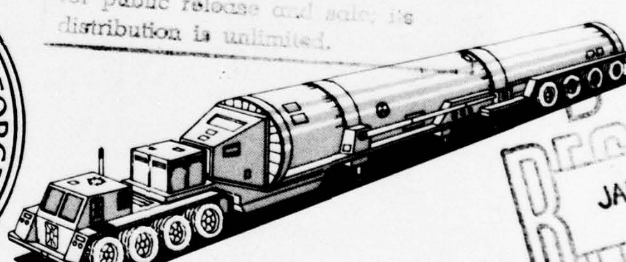
IV
Basing Mode Evaluation



Environmental Impact Analysis Process

FINAL
ENVIRONMENTAL IMPACT STATEMENT

MX: MILESTONE II

DEPARTMENT OF THE AIR FORCE

FINAL ENVIRONMENTAL IMPACT STATEMENT
MX MILESTONE II

VOLUME I: PROGRAM OVERVIEW

VOLUME I PRESENTS AN OVERVIEW OF THE ENTIRE MX SYSTEM INCLUDING:

- THE MX MISSILE AND BASING MODE ACQUISITION PROCESS
- THE ENVIRONMENTAL PROGRAM AND ENVIRONMENTAL STATEMENTS TO BE PREPARED FOR DECISION-MAKERS AND THE PUBLIC
- A SUMMARY OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF PAST AND FUTURE MX DECISIONS
- IDENTIFICATION OF FUTURE ACTIONS ANTICIPATED AS PART OF THE MX SYSTEM

VOLUME II: FULL-SCALE ENGINEERING DEVELOPMENT

VOLUME II ADDRESSES THE ENVIRONMENTAL IMPACTS OF EXPENDITURE OF RESOURCES TO DESIGN, CONSTRUCT, AND TEST MISSILE AND BASING MODE VEHICLE COMPONENTS AND THE ASSEMBLED MISSILE AND VEHICLES. KEY ISSUES ARE:

- *EXPENDITURE OF $5 TO $7 BILLION* FOR FULL-SCALE ENGINEERING DEVELOPMENT (FSED)
- CREATION OF JOBS THROUGHOUT THE NATION
- *GROWTH INDUCEMENT CONCENTRATED* IN 9 STATES
- CONSUMPTION OF ENERGY AND WATER RESOURCES
- ATMOSPHERIC EMISSIONS

VOLUME III: MISSILE FLIGHT TESTING

VOLUME III PROJECTS ENVIRONMENTAL IMPACTS OF MX FLIGHT TESTS ON VANDENBERG AIR FORCE BASE AND CENTRAL CALIFORNIA. KEY ISSUES INCLUDE:

- GROWTH RELATED IMPACTS TO NORTHERN SANTA BARBARA COUNTY
- CUMULATIVE IMPACTS OF MX, THE SPACE SHUTTLE, AND THE PROPOSED LNG PLANT
- FOUR CANDIDATE SITING AREAS (CSA) WERE EVALUATED TO ASSESS SITE SPECIFIC ENVIRONMENTAL IMPACTS RELATED TO THE FOLLOWING KEY ISSUES:
  - –TRANSPORTATION
  - –WATER RESOURCES
  - –RARE OR ENDANGERED SPECIES
  - –AIR QUALITY
  - –ARCHAEOLOGY
  - –MINERAL RESOURCES

VOLUME IV: BASING MODE EVALUATION

VOLUME IV EVALUATES THE ENVIRONMENTAL IMPACTS ASSOCIATED WITH THE FOLLOWING FOUR BASING MODES:

- *VERTICAL SHELTER*
- BURIED TRENCH
- HORIZONTAL SHELTER
- SLOPE-SIDED POOL

THE POTENTIAL FOR ENVIRONMENTAL IMPACT ASSOCIATED WITH EACH BASING MODE IS EVALUATED AT SEVEN BASING MODE COMPARISON AREAS (BMCA) THROUGHOUT THE WESTERN UNITED STATES. KEY ENVIRONMENTAL ISSUES INCLUDE:

- VARIATION OF SPACING BETWEEN AIMPOINTS
- AREA SECURITY VERSUS POINT SECURITY
- DISTURBED OR UNDISTURBED ENVIRONMENT
- PUBLIC OR PRIVATE LAND
- WATER RESOURCES REQUIRED
- CONSTRUCTION RESOURCES REQUIRED
- ENERGY RESOURCES REQUIRED

VOLUME V: APPENDICES

VOLUME V CONTAINS:

- BIOLOGICAL APPENDICES AND SPECIES LISTS
- REGIONAL INDUSTRIAL MULTIPLIER SYSTEM (RIMS) DESCRIPTION
- BASING MODE EVALUATION
- GLOSSARY
- REFERENCES

VOLUME VI: PUBLIC COMMENTS

VOLUME VI PRESENTS PUBLIC RESPONSE TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT. INCLUDED IN THIS VOLUME ARE:

- LETTERS RECEIVED FROM AGENCIES AND ORGANIZATIONS
- RESPONSES TO QUESTIONS RAISED BY THE PUBLIC
- PUBLIC HEARING TRANSCRIPTS

372P.994

BASING MODE EVALUATION SUMMARY

Four basing modes are considered in the Basing Mode Evaluation. The basing mode selected could impact considerable land areas, energy, natural resources, and the economy. The four basing modes are:

- horizontal shelter (a bunker-like structure)
- vertical shelter (an underground vertical tube)
- slope-sided pool (a covering of water for the missile)
- hybrid buried trench (a horizontal concrete tube structure)

Each basing mode analyzed employs the multiple aimpoint strategy which forces the enemy to target each shelter, trench aimpoint or pool if he is to destroy the United States ICBM retaliatory forces. In designing multiple aimpoint systems, strategists consider four points:

- hardness: the ability of the missile at the aimpoint to survive the effects of a nuclear blast at a selected distance
- dispersion: spacing between aimpoints so that an attack on one does not disable missiles at other aimpoints
- deception: methods which prevent the enemy from determining which aimpoints house missiles
- security:

  area—entire fenced regions in which the missile is deployed and from which unauthorized personnel are excluded

  point—only the immediate location surrounding the aimpoint is controlled; small area exclusion of unauthorized personnel with limited activity in a larger area

Environmental impacts associated with basing modes will vary by site location. Potential least cost engineering construction areas were divided into seven physical-biological provinces and sample Basing Mode Comparison Areas (BMCAs) were defined to prepare the environmental analysis. These BMCAs are chosen for environmental analysis only; no siting decisions are suggested by the BMCAs. The choice of a site is not to be addressed as part of Milestone II. The seven sample basing mode comparison areas are:

- Central Nevada Great Basin
- California Mojave Desert
- Luke/Yuma (AZ)
- White Sands (NM)
- West Texas-Rio Grande Basin (TX, NM)
- Texas/New Mexico High Plains
- South Platte Plains (NE, KS, CO)

Analysis and study of the BMCAs identified important environmental concerns in the basing mode selection which should be considered in deciding whether or not to proceed with full-scale engineering development.

Comparison of the four candidate basing modes indicates that the level of impacts associated with each option is roughly the same for each particular BMCA. Each basing mode offers certain advantages and disadvantages for particular environmental concerns, but impact potential varies significantly, more by site than by basing mode, and no consistent pattern of environmental impacts leading to a preferred basing mode can be discerned. Therefore, selection of a basing mode must be made in concert with other engineering and cost considerations.

- Concern with Important Species. The potential impacts of all modes upon important species are similar, ranging from small to moderate. The potential for adversely affecting one or more protected species exists virtually anywhere the project could be sited. Site-specific differences among the basing mode comparison areas are evident and outweigh variations among the basing modes. Area security fencing that does not allow passage of wildlife could be a significant problem in some areas. (The currently proposed fence does allow passage of certain wildlife.) Water use (especially in the slope-sided pool mode) could affect endangered fish species in isolated desert spring-fed pools by reducing their water supply.

- Air Quality. No major differences in impact potential can be attributed to a change in the basing mode. Site-specific meteorological conditions and ambient air quality present significant variations in the level of potential impacts. Impact potential is small, except in the California Mojave BMCA.

- Water Quality and Supply. Significant variations in the impact potential occur among the various BMCAs with relatively minor variations among the basing modes. Little difference in the impact potential levels exists between area security and point security.

  Water availability is highly site-dependent. Deployment of the MX system will require large quantities of water for concrete, dust suppression, compaction, and other uses. Some of the arid and semi-arid areas contain endemic fish which could be affected by project water use.

- Loss of Recreational Access. Basing modes utilizing point security reduce the impact potential in areas where there is a large proportion of currently accessible public land. The relatively small differences in construction and operations personnel and induced population growth associated with variations in basing mode and spacing cause no clear differences in the induced traffic congestion component to recreational access loss; however, this component does vary significantly with site depending upon the capacity of the road network.

- Natural Resources. Impacts involving aesthetic concerns, loss of natural vegetation and habitat value, and water resources are influenced by the amount of area disturbed by the project, the total area of the project, and water uses of the project. Impacts vary relatively little among modes, but reveal a strong site-specific component. Expanded spacing in any mode causes greater impacts by increasing all of the above environmental effects. Point and area security have relatively similar impact potential.

- Land Rights. No significant differences in the level of impact potential exist among the basing modes. The level of impact is affected more by the security configuration than by the choice of a site. Point security shows markedly reduced potential impacts. Site selection shows small differences because rural population density is greatest in productive agricultural areas with a high proportion of private land. Displacement of population and acquisition of private land are likely to produce moderate to large impacts.

- Economic Issues. No significant differences in the level of impact potential exist among the basing modes. Further, significant differences do not occur between alternative security

or between alternative spacing configurations. Impacts tend to be relatively large due to requirements for local governments to provide community facilities and service to support large-scale growth. The creation of new jobs that may be filled by local residents partially offsets this impact. Area security may produce somewhat greater impacts due to loss of production from current land uses, particularly if combined with expanded spacing.

- Local Government Issues. No significant differences in the level of impact potential exist among the basing modes. The level of impact potential is affected more by site selection than by the choice of a basing mode, with the California Mojave and Luke/Yuma showing low impact potential relative to Central Nevada, White Sands, or the South Platte areas. No significant differences occur in the level of impact potential when comparing point and area security or when comparing nominal and expanded spacing. Impacts are generally the result of in-migration of people requiring increased services and facilities to be provided by local governments from a limited tax base.

- Public Safety. The concern for public safety shows no significant variation in the level of potential impact among basing modes. The level of impact is affected more by site considerations and variations than by security configurations. Site selection shows the largest differences because the BMCAs have widely different population densities and therefore variation in the numbers of people concerned about safety issues. Potential impact levels are generally small in the areas with low population densities and moderate to large in areas with high population densities.

- Airways Impeded. Potential impact on airways shows very little variation among the different modes in area security. The impact potential is quite site-specific, varying from small to large, but increases considerably from nominal spacing, area security to expanded spacing, area security. Point security can be considered a mitigation of this potential impact as it does not require airway restrictions.

- Archaeological Issues. No significant differences in the level of impact potentials exist among the basing modes. Impacts are strongly site-dependent. Expanded spacing may incrementally increase the impact potential. Areas such as White Sands, Luke/Yuma, California Mojave, Central Nevada, and West Texas-Rio Grande are areas where archaeological remains have been well-preserved because of both the arid climate and the lack of intensive agriculture. White Sands and the California Mojave both have a high density in the types of archaeological sites that have been preserved.

- Cement. Construction of the hybrid trench may have large potential impact on availability of cement. The other basing modes show no difference in level of impact potential, with all modes producing small impacts. Area and point security have similar impact potential for all sites.

- Energy Issues. No significant differences in the level of impact potentials exist among the basing modes. Neither the proposed security systems nor the alternative spacings significantly affect the level of impact potential. The level of impact potential is more affected by site selection than basing mode but both the project requirements (including the project and the associated new population) and the levels of generating capacity that will be available depend on a range of unknowns.

Other alternatives to the proposed basing modes were rejected because they either lacked the necessary survivability in the event of an attack, were deemed not cost-effective, or they were impractical with the present technology, therefore they were not subjected to environmental analysis.

Alternatives to the selected basing modes were:

- use of existing silos for MX deployment
- air mobile options (use of wide-body jet aircraft or helicopter-dirigibles to carry and launch missiles)
- unprotected options (missile launch vehicles dispersed over roads, rails, waterways, or on unprepared surfaces)
- subterranean options (hard rock tunnel, soil tunnel)

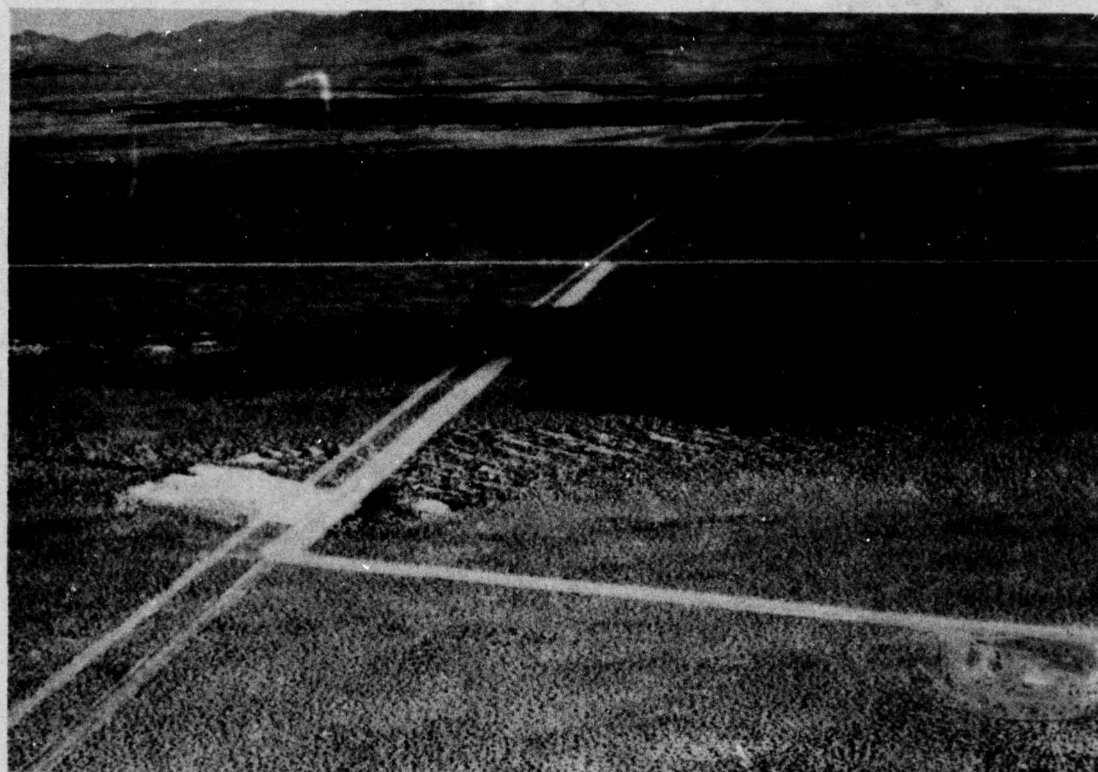
In addition, the following system alternatives/scenarios were evaluated:

- interim deployment of Minuteman III missiles in MX basing modes in southwestern United States
- MAP deployment of Minuteman III missiles in northern basing

CONTENTS

FIGURES

TABLES



Introduction

INTRODUCTION

One aspect of the Milestone II decision will be to select a basing mode or modes for MX deployment. Four basing modes and two deployment configurations appear capable of satisfying the mission requirement at this time. The purpose of this volume is to compare these basing modes and configurations from an environmental standpoint. If any of the modes or configurations are particularly desirable or undesirable on an environmental basis, the fact may aid in making the decision.

Section 1 describes the four modes and three configuration variables. The modes are the horizontal shelter, the vertical shelter, the slope-sided pool, and the hybrid inline trench. The configurations considered are area and point security, nominal and expanded spacing between aimpoints, and various force levels in any one location. Table 1 outlines the different factors considered in this basing mode evaluation volume.

Discussion of the environmental impacts of the various basing modes requires concurrent consideration of potential deployment areas. Areas for environmental analysis were selected from those that were geotechnically suitable and in which available construction techniques could be employed in a cost-efficient manner. The geotechnically suitable areas were found to fall into seven distinct physical-biological types, and a representative basing mode comparison area (BMCA) was selected from each type for the comparison. The BMCAs were chosen for environmental analysis only; no siting decision is suggested by the BMCAs. The choice of a site is not to be addressed as part of Milestone II.

Knowledge of the project parameters and the likely environment for deployment allowed the key concerns to be selected. These key concerns were principally the amount of area from which people would be excluded, the amount of surface which would be disturbed by construction, the amount of materials and resources which would be used, and the labor which would be required for construction and operation.

Table 1. Factors considered in MX: basing mode comparison studies.

BASING MODES CONSIDERED	Horizontal Shelter Vertical Shelter Slope-Sided Pool Inline Hybrid Trench
BASING MODE COMPARISON AREAS EVALUATED	Central Nevada Great Basin California Mojave Desert Luke Air Force Range/Yuma Test Site, Arizona White Sands Missile Range, New Mexico West Texas-Rio Grande Basin, Texas, New Mexico Texas/New Mexico High Plains, Texas, New Mexico South Platte Plains, Nebraska, Kansas, Colorado
ENVIRONMENTAL CONCERNS	Conservation (Interference with Important Species) Air Quality Water Quality and Supply Land Access Loss Use of Natural Resources Land Rights Economics Local Government Issues Safety Airways Impeded Archaeology Cement Electrical Energy
BASE SIZES	Full force at one base Two-thirds force at any one base One-third force at any one base
AIMPOINT SPACING	Nominal [2,300 to 5,000 ft (700 to 1,500 m)] Expanded [up to 8,300 ft (2,500 m)]
SECURITY CONFIGURATIONS	Point Area
NORTHERN BASING	Minuteman III in a MAP deployment mode

Each BMCA has different characteristics. These are described with regard to physical, biological, and socioeconomic features.

Section 2 briefly describes the land use of each basing mode comparison area. Present and proposed future land use and ownership are addressed as they relate to the alternative basing modes.

Section 3 compares the impacts of the various modes and configurations. The beginning of this section is devoted to describing the analysis technique. Functional relationships are determined between the project parameters and the primary factors, between the primary factors and the basic environmental variables, and between the basic environmental variables and the relative impact potential. Forty of the basic environmental variables have been selected as either important or potentially controversial for this project. These environmental variables have then been aggregated into anticipated concerns of interested parties.

The final portion of Section 3 summarizes the results of these anticipated concerns and discusses the implications of the concerns as a comparison tool. The range of projected results and the implications for each environmental concern are presented for Air Force and public decisionmakers.

Section 4 briefly discusses all of the alternatives which were initially considered for MX basing. The alternatives fall into five basic groups:

- no project
- alternatives other than MX
- air mobile basing which includes deploying MX in aircraft, helicopters, or heliostats
- unprotected basing which depends solely on mobility and location uncertainty for protection. This includes rail, highway, and offroad transport-launchers.
- protected basing which combines some form of protection with location uncertainty for protection. This includes all of the options considered in this report plus others.

The reasons for rejecting those basing alternatives not considered in this report are listed. These reasons are usually uncertain effectiveness, high cost, or current technical infeasibility.

Section 5 presents the probable unavoidable adverse environmental effects which might occur due to the various MX basing modes. In addition, mitigation measures are proposed for many of these unavoidable effects. The relationship between local short-term uses of man's environment and the long-term productivity are discussed in Section 6.

Section 7 covers the irreversible and irretrievable commitments of resources which would occur should MX basing be implemented. In Section 8, considerations are given which would offset the adverse impacts of MX basing mode implementation. Section 9 presents the issues which, at present, are unresolved and need further consideration.

Project and Environment

1
THE PROJECT AND THE ENVIRONMENT

In its broadest sense, "The Project" addressed in this volume of the FEIS for the MX Milestone II decision is selection of a multiple aimpoint (MAP) basing mode for Missile X. Environmentally, this is a key decision, since the largest potential for environmental impact in the program is associated with construction and operation of the system after Milestone III. It is important, therefore, that the basing mode selected have the minimum environmental impact consistent with operational needs.

Basing mode options are described in detail in Volume I; they are summarized in this section for the convenience of the reader. All options use the multiple aimpoint (MAP) concept.

In the MAP concept, the missiles are moved deceptively among a large number of protective structures or aimpoints. The aimpoints are designed to protect the missiles against the effects of a nuclear attack, but cannot be designed to withstand a close burst of a high-yield warhead. They are therefore constructed to a reasonable level of "hardness," and separated by distances such that a warhead of sufficient yield and accuracy to destroy one aimpoint cannot destroy adjacent aimpoints.

Numerous aimpoints are provided for each missile. The missiles are then moved periodically among aimpoints in such a way that their locations are unknown. In order to attempt destruction of the missile force, an aggressor must therefore target all of the aimpoints. If the number of aimpoints is sufficiently large, an aggressor either will not have enough weapons to attack them all, or would deplete his weapon inventory to unacceptable levels if he elected to attempt destruction of the ICBM force.

<u>Aimpoint Configurations</u> (1.1.1)

<u>Inline Hybrid Trench</u> (1.1.1.1). The buried trench MAP concept envisions movement of the missile within shallow-buried concrete tubes, each of which has a large number of protective structures or aimpoints. The unmanned missile is moved among aimpoints automatically on command. In the "inline hybrid" concept, the protective structures are sections of trench of sufficient strength to withstand a selected level

of attack effects, and sealed with "blast plugs" to withstand the effects of an attack that breaks the interconnecting sections of less-resistant tube.

For firing, the missile (in a protective cylinder or canister) is erected through the concrete tube and earth cover. The concrete tube at the aimpoint is specially designed to facilitate breakout.

The hybrid inline trench includes:

- The continuous soft trench (in which "hardness" would be carried with the missile)
- The continuous hardened trenches (all sections as resistant to attack as the aimpoint proper)
- "Spur" options in which the aimpoints would be accessible from the buried tube, but not formed by the tube itself

Horizontal Loading-Dock Shelter (1.1.1.2) The horizontal loading dock shelter consists of a section of concrete tube, buried under a protective earth cover. The tube is long enough to house the missile on its launch vehicle (MLV) and is sealed by a protective door carried by the MLV transporter vehicle (MLVT). All shelter openings are fitted with antisurveillence shields, so that the shelter containing the missiles cannot be discriminated from the empty ones.

A downramp and concrete apron provide access to the shelter entrance. The bottom of the shelter is above the level of the concrete access apron, and the MLV guides itself into or out of the shelter automatically, under cover of the MLVT.

A network of roads interconnects all shelters, permitting deceptive moves. In making a deceptive move, the MLVT visits many shelters, simulating emplacement or removal of a missile at all but the one at which a transfer is actually made. In this way, missile location remains uncertain to an observer.

For launch, the MLV drives partially out of the shelter, with the section containing the missile suspended over the access apron. The blast door falls into the space below the shelter entrance; this space also allows for build-up of attack-induced debris without impeding MLV egress. The canistorized missile is then erected and fired.

The horizontal loading-dock shelter includes:

- Hardened plow-out shelters, in which the missile-launch vehicle plows out through attack-induced debris onto the shelter-access apron before erection and firing.

- Hardened break-out shelters, similar in concept to buried-trench aimpoints interconnected by roads instead of buried concrete tubes.
- Soft shelters, with carried hardness.

The shelters can all be fitted with blast doors, or the blast doors can be carried from shelter to shelter by the transport vehicle. The carry-door concept requires more load-capable roads then the fixed-door concept, and thus entails somewhat more environmental disturbance, but reduces system cost. The loading-dock concept requires smaller shelter diameters (reducing materials requirements, excavation, and cost), but also requires substantial roads because the MLVT must carry the entire MLV (and, for cost-effectiveness, the blast door as well). Roadable missile launch vehicles must be used in conjunction with anti-surveillence vehicles to ensure deception.

Vertical Shelter (1.1.1.3) The vertical shelter consists of a buried vertical section of concrete tube, sealed by a blast door. The top of the shelter is at ground level. The canistorized missile is moved among shelters in a horizontal position by a transporter-emplacer vehicle. The missile is erected for emplacement or removal, under cover of a protective container on the transporter/emplacer.

Deceptive above-ground moves are required with the vertical shelter, as described for the horizontal shelter.

For launch, the missile is elevated partially above ground level, and the blast door and some operational support equipment is jettisoned. Erection is not required, since the missile is stored vertically.

The fixed or carry door option also applies to the vertical shelter. A soft shelter with carried hardness was also considered as an option.

Slope-Sided Pool (1.1.1.4). The slope-sided pool is essentially a small artificial lake, with the water contained by a suitable liner. A concrete down-ramp and pad at the bottom of the pool provides access by a missile Platform Transporter (PT), that emplaces or removes a missile Launch Platform (MLP). A radar-reflective visual shield prevents observation of the presence or absence of a missile, and the PT provides concealment of the MLP during deceptive moves.

For launching, the canisterized missile is erected, the waterproof muzzle closure is opened, and the missile is fired.

The slope-sided pool includes:

- A vertical-wall pool, in which the water is contained by a concrete structure, and the missile is emplaced in a horizontal position
- A vertical-wall pool similar to a vertical shelter

Security Variants (1.1.2)

The deployed missiles and their associated equipment must be protected against detection, unauthorized access, and sabotage. In a multiple aimpoint system, it is vital that the attacker be denied knowledge not only of which aimpoints contain a missile, which would then be targeted, but also which aimpoints do not contain missiles and need not be targeted. An effective security system is thus required for all aimpoints. The exact configurations of these classes are subject to additional analysis and design during FSED. The following discussion is based on the present, tentative conceptualization of these configurations (Figures 1-1 and 1-2).

Two broad classes of security concepts have been identified for the MX system, termed "point" and "area" security.

In point security, only a small area immediately surrounding the aimpoint is fenced. The fence provides a physical barrier to impede access to the aimpoint. Intrusion sensors protect the fenced area around the aimpoint, and security forces are dispatched when an intrusion is detected.

A safety zone is also established around each aimpoint because of the potential hazard from propellants if a missile is present. The size of this safety zone is determined by the explosive hazard. Inhabited structures are not permitted within the safety zone, and roads must be more than a specified distance from the aimpoint. Where private lands are involved, easements must be obtained from the owners to restrict construction of habitable buildings, but other uses (agriculture, recreation, etc.) are permitted.

Access to the entire point-security area is unrestricted except within the relatively small fenced zone around each aimpoint and at the support areas for the deployed force. Control of the airspace above the parcel is not required, since there is freedom of movement on the ground. Adequate measures must consequently be taken to counter portable or emplaced sensors, possibly including use of decoys simulating the missile

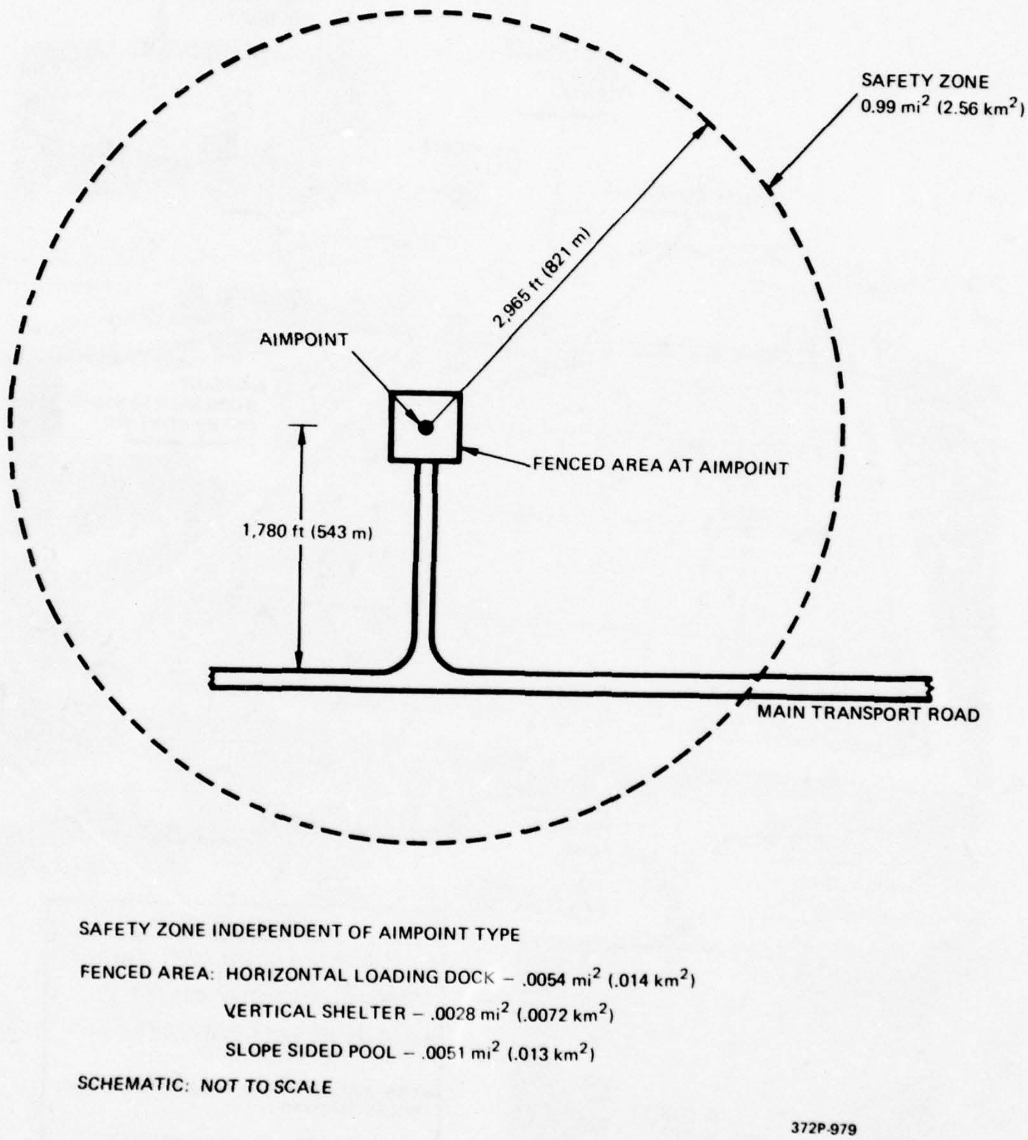


Figure 1-1. Point security area requirements for MX aimpoint.

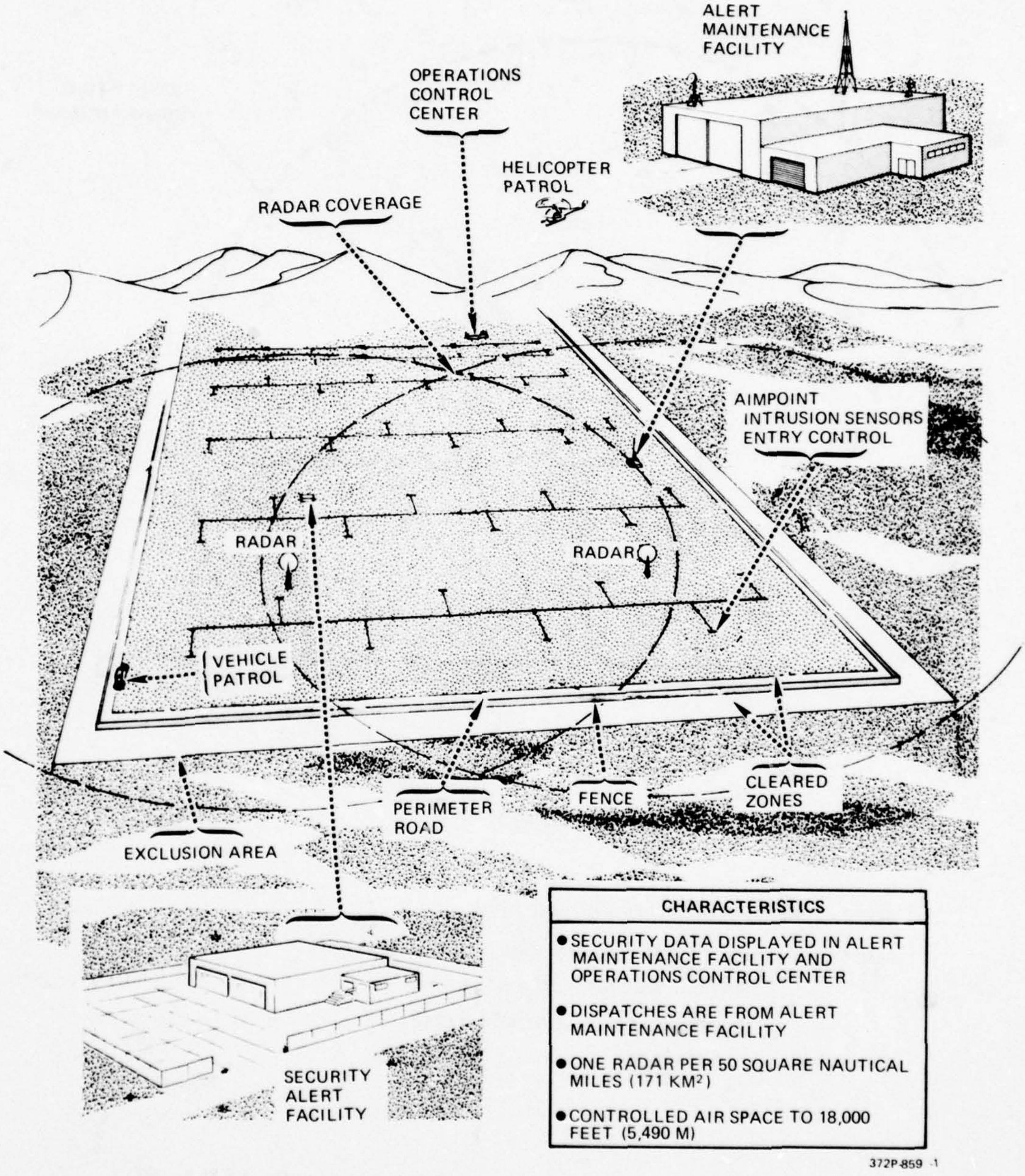


Figure 1-2. Area security concept for discrete aimpoint system.

at each aimpoint, and/or frequent "sweeping" activities to detect emplanted sensors. Similarly, physical security may require the use of large escort teams during deceptive or maintenance movements of missiles or decoys. Security system acquisition and maintenance costs are consequently increased. These factors will be explored during Full-Scale Engineering Development.

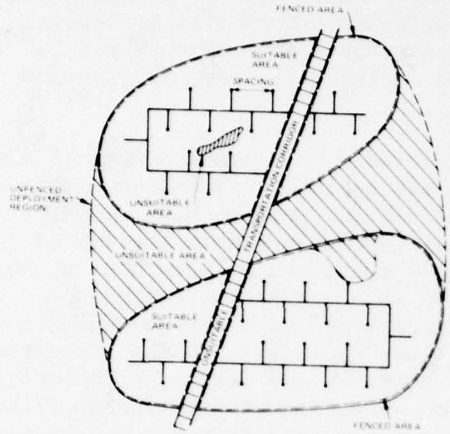
In the area security mode, the larger area in which a number of aimpoints and a smaller number of missiles are deployed, is enclosed by a warning fence and posted notices, with a cleared area on both sides of the fence. Only authorized personnel are permitted within the fenced area, and their movements are continuously monitored by personnel at an Operations Control Center (OCC) and at an assigned Alert Maintenance Facility (AMF). Security forces with appropriate vehicles and weapons are housed at the AMF, and at Security Alert Facilities (SAFs) dispersed throughout the controlled areas. Entry controls and intrusion sensors are also provided at each aimpoint. Upon detection of penetration of the area by unauthorized personnel security forces are dispatched to assure interception.

To prevent implantation of sensors from aircraft, the airspace over area security deployment areas is restricted (no access) to an altitude of 5,000 ft (1,524 m) above ground level, and controlled (permit required) to an altitude of 18,000 ft (5,486 m). Perimeter vehicle patrols and helicopter patrols are maintained as necessary to ensure security of the deployment area.

Fenced areas will be of radically different sizes for point and area security modes and this constitutes a major and important difference between these two security configurations. As a rough first approximation, geographic deployment regions will be the same for both point and area security. However, if aimpoints are located for minimum population impact in the point security configuration, e.g., minimize necessity for people moving, the point security mode may have a larger overall deployment area than the area security mode. Safety areas will only apply to point security. For the area security mode, it is expected they will be included inside the fenced area.

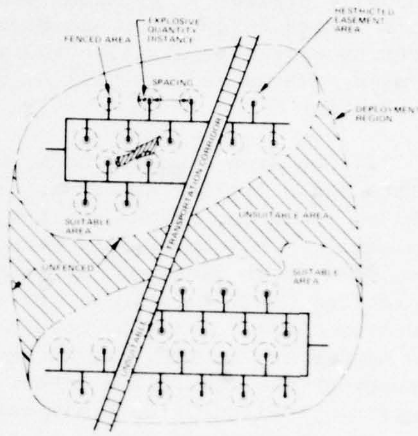
Below is a graphic representation of point and area security land use. As shown, the fenced areas can be separated so as to avoid transportation corridors and otherwise unsuitable areas such as large population centers.

Another possibility that could mitigate the impact of the large fenced areas required by the area security mode is the concept of "split-basing." In this concept, the total missile force may be divided into two or more major groupings, and deployed at geographically separated locations. This would allow more flexibility in avoiding populated, or otherwise unsuitable, areas because of the relatively smaller fenced land requirement at each deployment.



AREA SECURITY

EACH OF THE TWO SUITABLE AREAS WILL CONTAIN ABOUT 24 MISSILES, 480 SHELTER OR 52 TRENCH AIMPOINTS. THIS AREA WOULD BE APPROXIMATELY 300-500 sq. n. mi. AND THE ROUGH DIMENSIONS WOULD BE 15 n. mi. BY 35 n. mi.



POINT SECURITY

Point security should have less impact on existing land uses and may therefore have some advantages. On the other hand, area security may have operational advantages. These environmental and operational factors will be considered, along with split basing, in deciding which security concept will be used.

<u>Support Facilities</u> (1.1.3)

A range of support facilities is required for deployment of the system.

In general terms, these include:

- A Strategic Missile Support Base, for command, logistics support, housing, and related functions.
- A Primary Support Area (PSA) for missile and reentry vehicle assembly and maintenance, and related functions.
- Alert Maintenance Facilities (AMFs), to provide personnel and facilities for rapid in-field maintenance and repair, monitor security stations, and house a security strike team.
- Security Alert Facilities (SAFs) to house additional security strike teams throughout the deployment area.

- Normal and standby electrical power facilities.
- Other facilities as required by the specific mode or area size, e.g., Auxiliary Operational Control Centers may be required if areas used are very large; an Exchange Building may be required for "scrambling" missiles and decoys if certain types of decoys are adopted.

MX Deployment (1.1.4)

MX deployment has been addressed with respect to the following four factors:

- Type of aimpoint (1.1.1)
- Area or point security (excluding trench for point security) (1.1.2)
- Nominal or expanded spacing.
- Single or split basing.

Survivability of retaliatory strike-force is related to the degree of hardness of the aimpoints, the number and spacing of the aimpoints, and the number of missiles. Two different sets of such combinations were studied for this environmental statement. The first, called the nominal spacing set, would give essentially equal retaliatory capability for a postulated attack scenario, at minimum cost for each mode. The second, called the expanded spacing set, are similarly comparable for a more severe attack scenario. Table 1-1 gives the nominal values for those systems parameters which were used in this study for each of the four area security and three point security options considered, assuming a 5-year construction period.

Split basing is a concept for mitigation of environmental effects associated with deployment of a mobile ICBM system in a single concentrated region. The selected siting regions would have to be separated geographically by a sufficient distance that their radii of influence for various factors would not have significant overlap: e.g., they would draw from different labor pools, commercial power sources, water supplies, etc., and would influence different communities.

For each such separate base, support facilities must be provided that could otherwise be shared in a single base. For example, each separate base will require construction, expansion, or reactivation as appropriate of a Strategic Missile Support Base (SMSB) with its operational, logistics support, maintenance, and related facilities; and construction of a Primary Support Area (PSA) for missile assembly, warhead maintenance and related activities. The total numbers of other facilities required (e.g., Alert Maintenance Facilities, Security Alert

Table 1-1. System parameters and their values for the deployment modes considered.

PARAMETER	VALUE FOR MODE (FULL FORCE CONFIGURATION)							
	HORIZONTAL SHELTER		VERTICAL SHELTER		SLOPE SIDED POOL		HYBRID TRENCH	
	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED
AREA SECURITY								
Missiles	250	250	230	275	205	205	198	250
Aimpoints/Missile	19	19	20	17	26	26	52	49
Aimpoints	4,750	4,750	4,600	4,675	5,330	5,330	10,296	12,250
Spacing in ft (m)	5,000 (1,500)	8,800 (2,700)	3,800 (1,200)	7,000 (2,100)	4,300 (1,300)	7,300 (2,200)	2,200(670)*/ 3,400(1,000)**	2,700*/(800) 4,800**/(1,500)
Aimpoints Constructed per year	950	950	920	935	1,066	1,066	2,059	2,450
POINT SECURITY								
Missiles	250	250	230	275	205	205		
Aimpoints/Missile	19	19	20	17	26	26		
Aimpoints	4,750	4,750	4,600	4,675	5,330	5,330		
Spacing in ft (m)	5,000 (1,500)	8,800 (2,700)	3,800 (1,200)	7,000 (2,100)	4,300 (1,300)	7,300 (2,200)		
Aimpoints Constructed per year	950	950	920	935	1,066	1,066		

*Along trench.

**Between trenches.

NOTE: For 1/3 and 2/3 force configurations, divide missiles, aimpoints/missile, aimpoints, and aimpoints constructed per year by 3 and 3/2, respectively. Spacing remains the same.

Facilities, electrical substations, etc.) may also increase. Increases can be expected in the total number of personnel, contributing to the life-cycle costs of the deployed system. Estimated life-cycle costs for the system will increase by approximately $1 billion for each separate installation.

Split basing thus involves a tradeoff between increased costs and potential environmental benefits. The number, if any, of such separate areas should be reduced to the smallest acceptable value because of the substantial cost impact. Moreover, with a large number of separate bases, use of the specialized facilities (many of which cannot be reduced in scale, e.g., the missile assembly building) and the skilled personnel required becomes inefficient, potentially leading to even larger life-cycle costs than would result from multiplying the estimated $1 billion by the number of bases. In comparison to the total life-cycle costs, a split into two, or possibly three separate bases is potentially worth consideration if the resulting benefits are judged warranted by the increased costs.

The area or areas in which the system would be deployed will not be determined until a later date. Potential areas, and the Basing Mode Comparison Areas (BMCAs) used for impact evaluation, are described in Section 1.2. These have been referred to herein as Southwest basing areas.

Minuteman III Northern Basing (1.1.5)

As an alternative to MX (or alternative missile) Southwest basing, conversion of Minuteman III (MM III) to a mobile ICBM in the point security vertical-shelter option is being considered. In this concept, vertical shelters similar to (but smaller than) those proposed for MX would be constructed in existing Minuteman III deployment areas in the northern tier of states.

Under this option, it would be necessary to convert the existing MM III for transportation in a horizontal position and for cold launching (see Figure 2-2, p. 1-13 of Volume I). To minimize vehicle weight, it would also be necessary to transport and emplace certain items of operational support equipment (OSE) separately from the missile proper. Existing public roads would be improved as necessary to permit transportation of the missile among aimpoints. Both the missile and the mobile OSE would have to be moved deceptively. Decoys may also be required; further studies in this regard will be conducted during FSED if this option is adopted.

Figure 1-3 shows the generic concept. The missiles would be deployed in the point security mode, much as MM III is today. To the extent feasible, shelters would be interspersed with existing minuteman silos. The same support bases could be used (expanded as necessary), but additional facilities would be required (e.g., a Primary Support Area, Alert Maintenance Facilities, Security Alert Facilities, and an Exchange Building if Decoys, possibly including Mobile OSE, are necessary.

Under this option, it is expected that the force will be as follows:

550	missiles
20	aimpoints per missile
11,000	total aimpoints
7,000	ft (2,100 m) spacing between aimpoints
1,570	ft (500 m) safety zone around each aimpoint
720	ft (220 m) setback from public roads
	vertical shelter basing

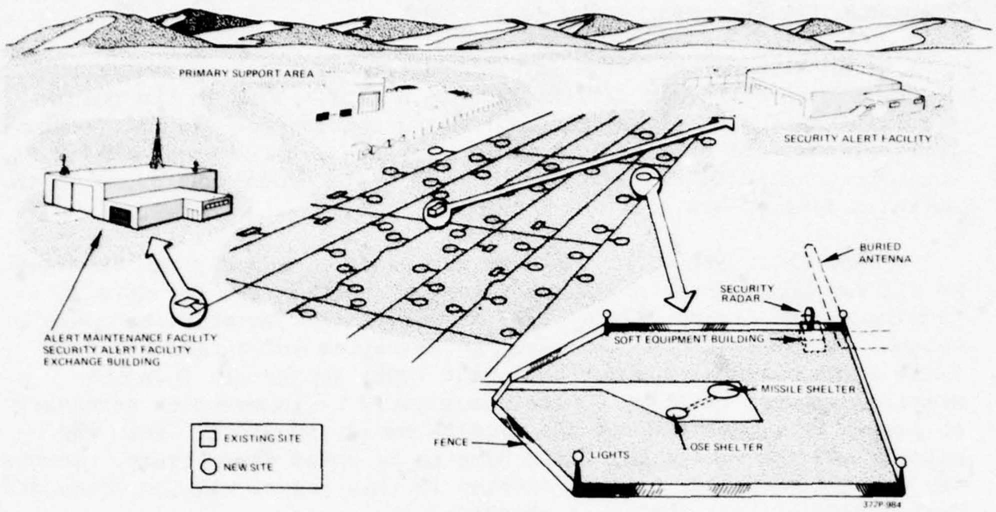


Figure 1-3. Minuteman III northern generic concept.

The missiles were assumed to be distributed in wings as they are today except for Wing I which might cause construction problems. Therefore, distribution is:

Wing III	(Minot AFB)	175 MM III	3,500 Aimpoints
Wing V	(Warren AFB)	200 MM III	4,000 Aimpoints
Wing VI	(Grand Forks AFB)	175 MM III	3,500 Aimpoints

See Figure 1-4 for locations.

Although the missile distribution is a little different from present distribution, the 20-to-1 ratio of aimpoints to missiles means that the areas concerned will experience approximately a twenty-fold increase in aimpoints. Thus, almost nothing will remain the same except perhaps the command structure.

The Northern Basing region is subject to severe winter weather, up to and including occasional blizzards. This will have two important effects on the project:

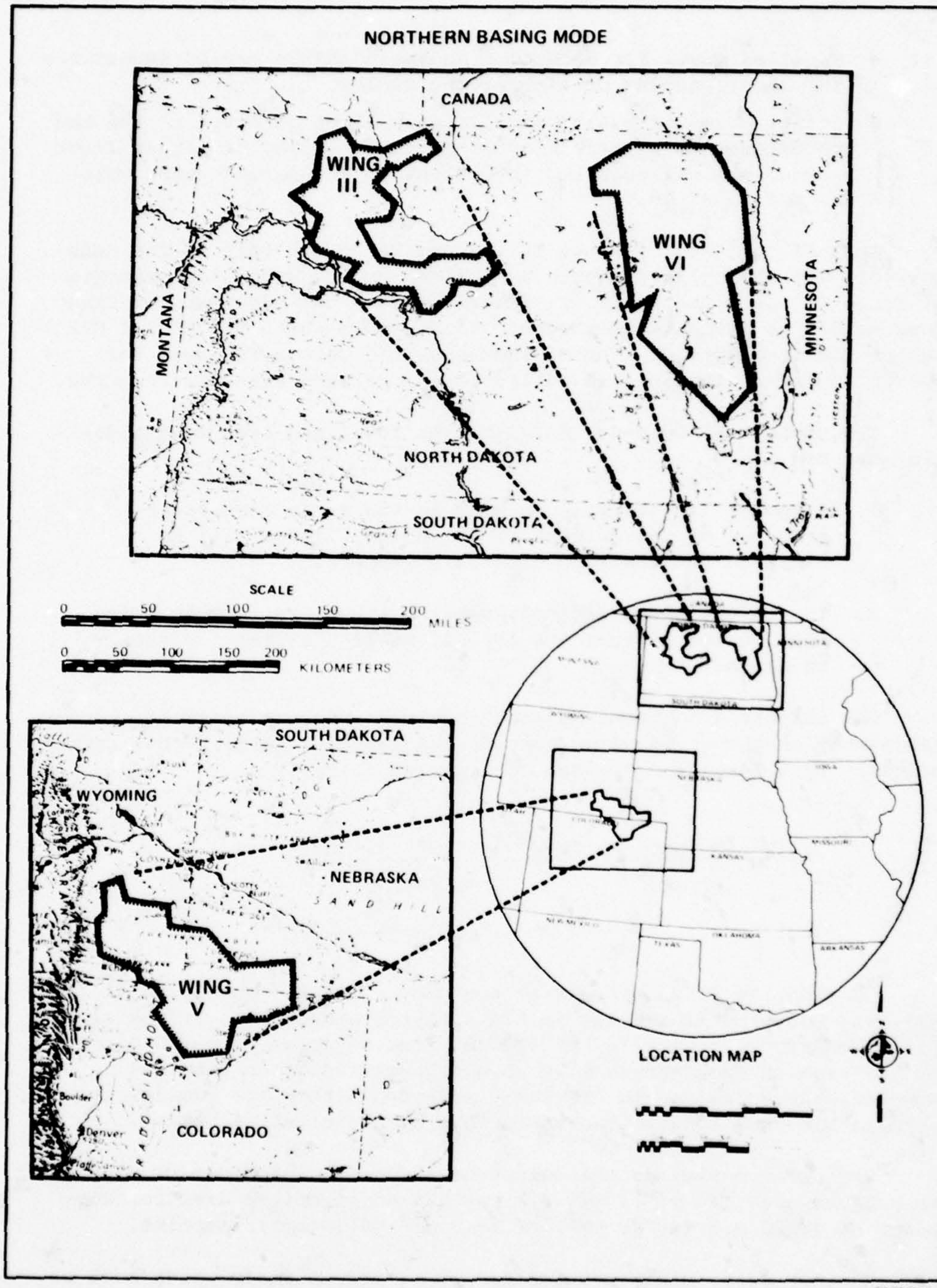


Figure 1-4. MM III locations

- Missiles moves for deception and maintenance may be impossible for short periods of time in the winter.
- Construction of basing facilities will be affected by the bad conditions to either delay achievement of IOC or larger labor forces will be required to compensate for periods when work is not possible.

Most of the area of Wings III, V and VI do not fall in the category of geotechnically suitable as defined by the screening criteria of Table 1-3 (see Section 1.2). Therefore, it was necessary to find some method to estimate the amount of area over which the MM III MAP system would be spread. The minimum possible area using only the spacing between aimpoints is called the "idealized area" is required.

Two steps will be used to relate the idealized area to the deployment region:

1. Aimpoint layouts will be made in two areas each taken from one of the present MM III Wings. These will be compared to idealized area requirements.

2. The layout areas will be compared to the rest of the Wing area to see if they are typical or if a correction factor is needed.

The idealized "closest packing" minimum area per aimpoint can be calculated on the basis of an hexagonal array of a large number of aimpoints. This idealized minimum area per aimpoint is

$$\frac{0.866\ (\text{Spacing in feet})^2}{(\text{ft/mi})^2} = \frac{0.866\ (7{,}000)^2}{(5{,}280)^2}$$

$$= 1.52\ \text{mi}^2/\text{aimpoint}$$

Considering a landscape with roads on a one-mile or 5,280 ft (1.6 km) grid adds inefficiencies to the array of aimpoints. If the aimpoints must be set back 720 ft (220 m) from any road, then 46 percent of the area in each square mile is not permitted as an aimpoint. However, the array can be carefully adjusted within the remaining permissible area to give two variations of efficient placement.

One array maximizes the number of aimpoints which can be placed in a given area (48 mi^2). This array has an effective area per aimpoint of 48/30 mi^2 (48/78 km^2) or 16.0 mi^2 (4.14 km^2)/aimpoint.

Another array minimizes the amount of access roads which must be built from present roads to the aimpoints. This array has an effective area per aimpoint of 48/24 mi^2 (62 km^2) or 2.0 mi^2 (5 km^2)/aimpoint.

Since building of access roads requires both road construction expenses and land requisition costs, the minimum access road array will be assumed to be the one used.

In a preliminary attempt to estimate real efficiencies of siting in the Northern Plains, two layouts were constructed. Each layout covered a 96 mi^2 (249 km^2) section present-day MM III deployment area. One layout was within the Minuteman Wing III area and one in the Wing VI area. The area in Wing III (Minot AFB) used for a layout (see Figure 1-5) is roughly bounded by longitudes 100°30'W and 100°47'30"W, and by latitudes 47°59'N and 47°52'30"N. The area in Wing VI (Grand Forks AFB) used for a layout (see Figure 1-6) is roughly bounded by longitudes 97°37'30"W and 98°00'W and by latitudes 47°00'N and 47°07'30"N. The criteria used for rejecting or relocating sites in the pattern were:

1. Within 600 ft (183 m) of a lake or large pond
2. In terrain with slopes greater than 5 percent

These two layouts resulted in placing 77 aimpoints in an area of 192 mi^2 (497 km^2) for an effective area per aimpoint of 2.49 mi^2 (6.45 km^2).

Since residences were not shown on the topographic maps used, an estimate was needed of how many of the sites from the layouts would be unusable because they would displace inhabitants. (No structures are allowed within 1,570 ft (480 m) of a MM III missile for safety reasons). It was assumed that sites would be rejected rather than inhabitants displaced. This factor was estimated from population densities to be about 1.25. Combining the correction with the layout value, the effective area per aimpoint becomes 3.13 mi^2 (8.1 km^2), This corresponds to a terrain factor of 2.1.

Comparing the two layout areas to their entire wing areas, one finds that the layout areas were more likely to provide good sites than the average. Estimates of the correction were 15 percent in Wing VI and 20 percent in Wing III. Averaging this to a17.5 percent correction and combining it with the layout terrain factor gives a deployment region terrain factor of 2.47.

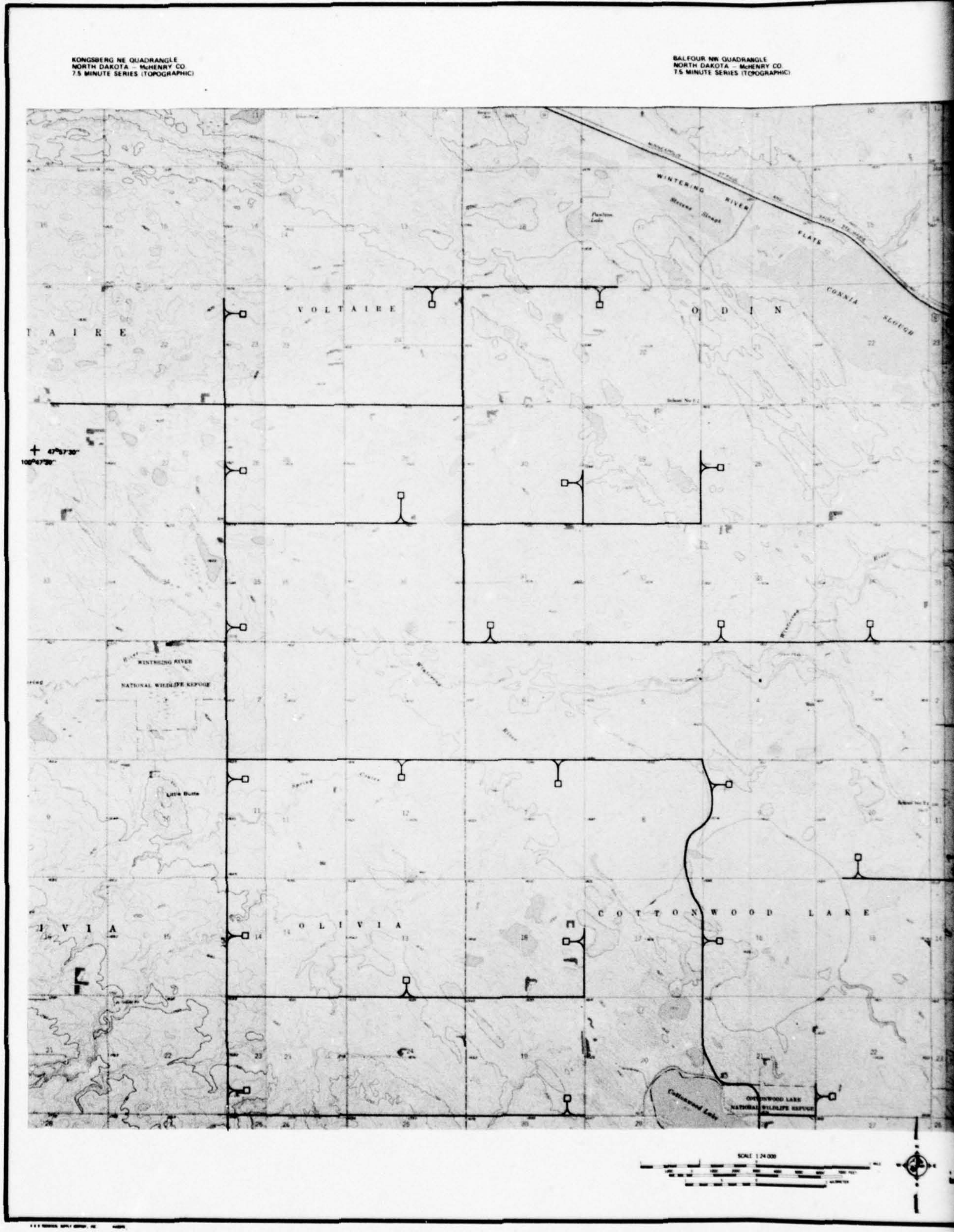
Minuteman III - Interim Southwest Basing (1.1.6)

As a hedge against increasing vulnerability of ICBMs in fixed (silo) deployment, interim deployment of modified MM III missiles in full-scale MX facilities is being considered as an option. The MX facilities would be constructed at full scale, and modified Minutemen installed in advance of MX availability. The MM III would be replaced by MX missiles at the end of full-scale MX construction and deployment.

Further details are given in Section 4.1.1.

Other Alternatives (1.1.7)

Alternatives than those discussed above (other than use of alternative missiles such as a common MX/Trident II) are generally considered infeasible. They are addressed in Section IV.


KONGSBERG NE QUADRANGLE
NORTH DAKOTA – McHENRY CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
BALFOUR NW QUADRANGLE
NORTH DAKOTA – McHENRY CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
WINTERING RIVER
FLATS
VOLTAIRE
O D I N
TAIRE
47°57'30"
100°47'30"
WINTERING RIVER
NATIONAL WILDLIFE REFUGE
Little Butte
COTTONWOOD LAKE
OLIVIA
IVIA
Cottonwood Lake
COTTONWOOD LAKE
NATIONAL WILDLIFE REFUGE
SCALE 1:24 000

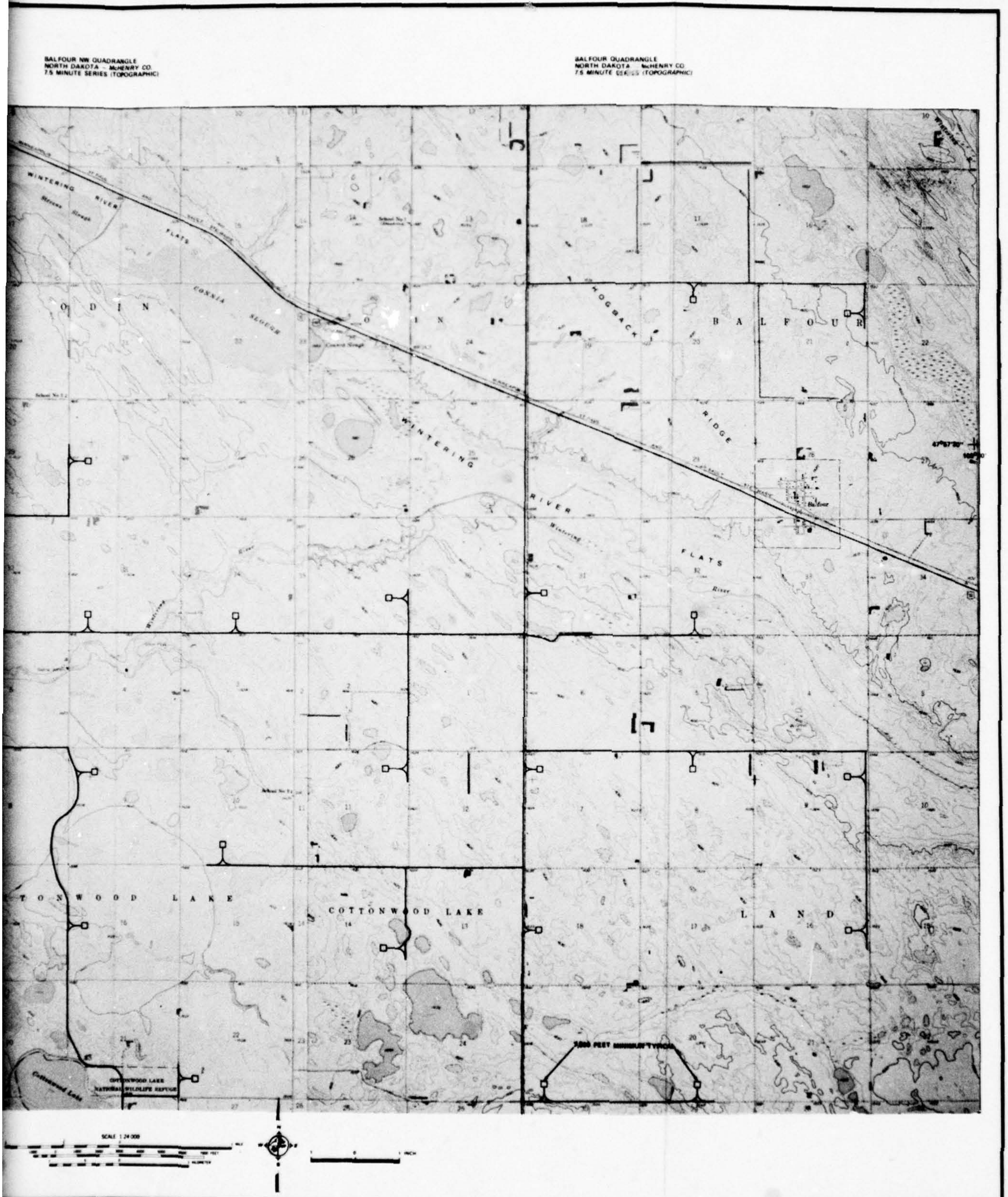
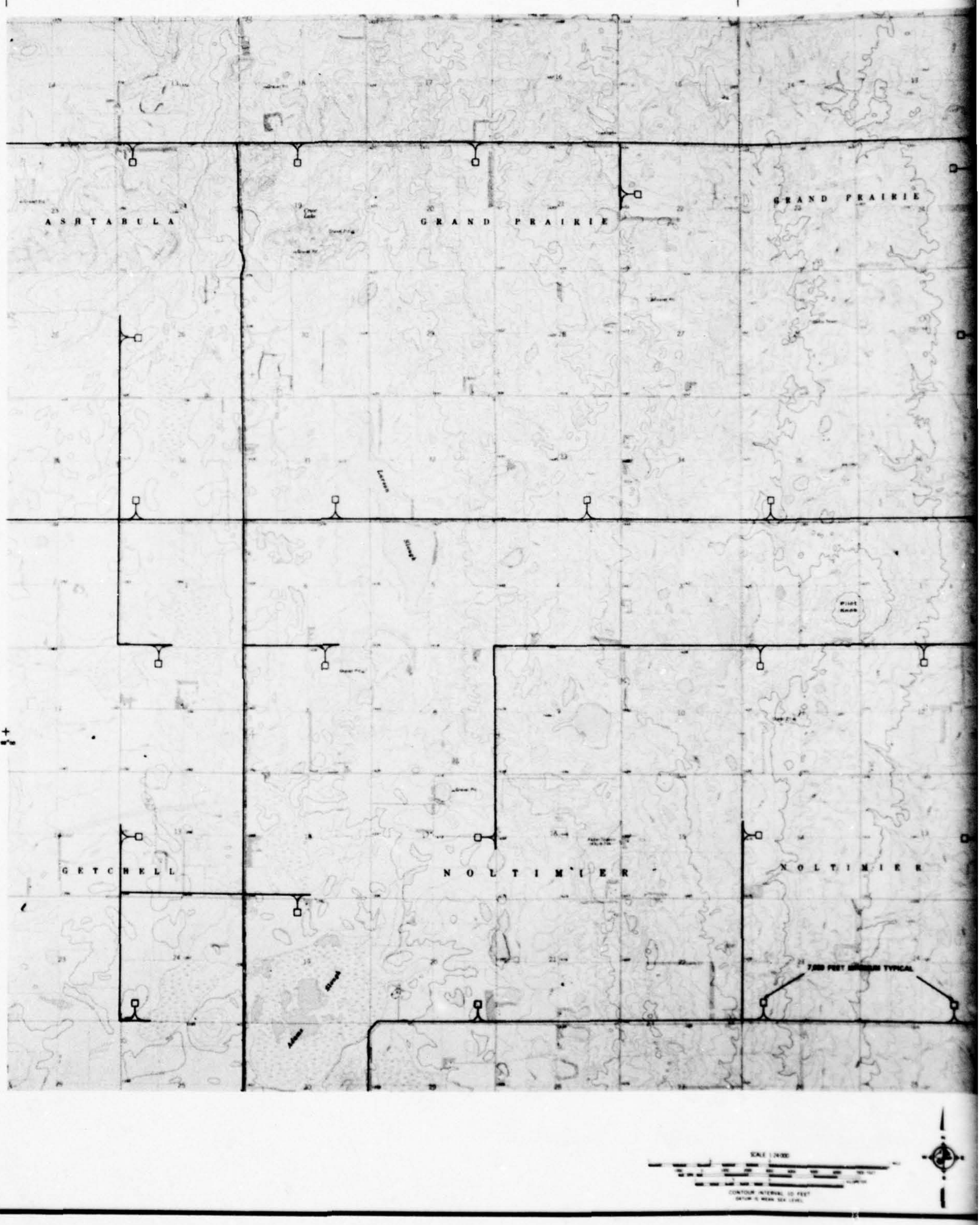


Figure 1-5. Wing III sample aimpoint layout.

2

PAGE SW QUADRANGLE
NORTH DAKOTA
7.5 MINUTE SERIES (TOPOGRAPHIC)



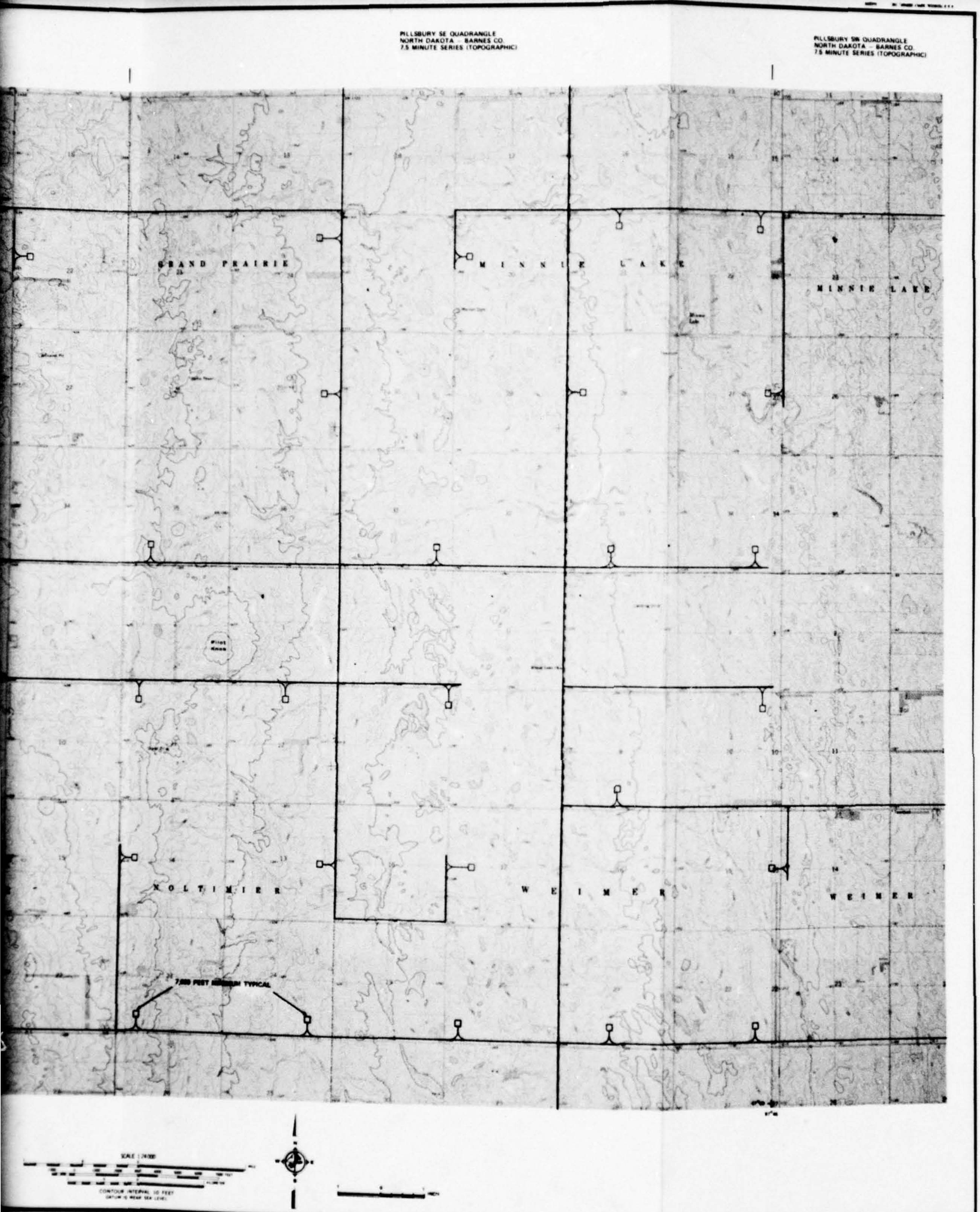


Figure 1-6. Wing VI sample aimpoint layout.

2

1.2 THE ENVIRONMENT

Selection of the Basing Mode Comparison Areas (1.2.1)

Using the engineering configurations and system parameters given in Table 1-1, areas required, surface disturbed, materials needed, labor required and energy necessary can be calculated for each mode. However, to assess impacts, detailed information on the physical, biological, and socioeconomic implications of these factors is necessary. The impact cannot be determined without a baseline. The value of impacts must be known, requiring site-specific information. The problem evolves into finding a way to cover the range of characteristics that potential sites will have and to analyze these possibilities. The solution is to select sample deployment regions which will allow the analysis needed for basing mode comparison over the range of possible system parameters.

The procedure for selecting sample deployment regions and basing mode comparison areas (BMCAs) is a three-level process.

- The possible MX deployment areas are determined by means of a set of geotechnical criteria.
- The geotechnically suitable areas are broken up into relatively homogeneous regions.
- The proposed land use and control for the various basing modes and system parameters is defined.

Geotechnically Suitable Areas 1.2.1.1. Suitability of the entire conterminous United States has been screened against three levels; coarse, intermediate and fine, of geotechnical and cultural criteria to determine areas suitable for construction of multiple aimpoint facilities. Graphic representation of this screening is shown in Figure 1-7.

Coarse screening used geotechnical, e.g., depth to rock and water; and cultural, e.g., exclusion of cities and national parks; criteria to reduce the conterminous United States to 226,630 square nautical miles (777,115 km^2) of suitable area.

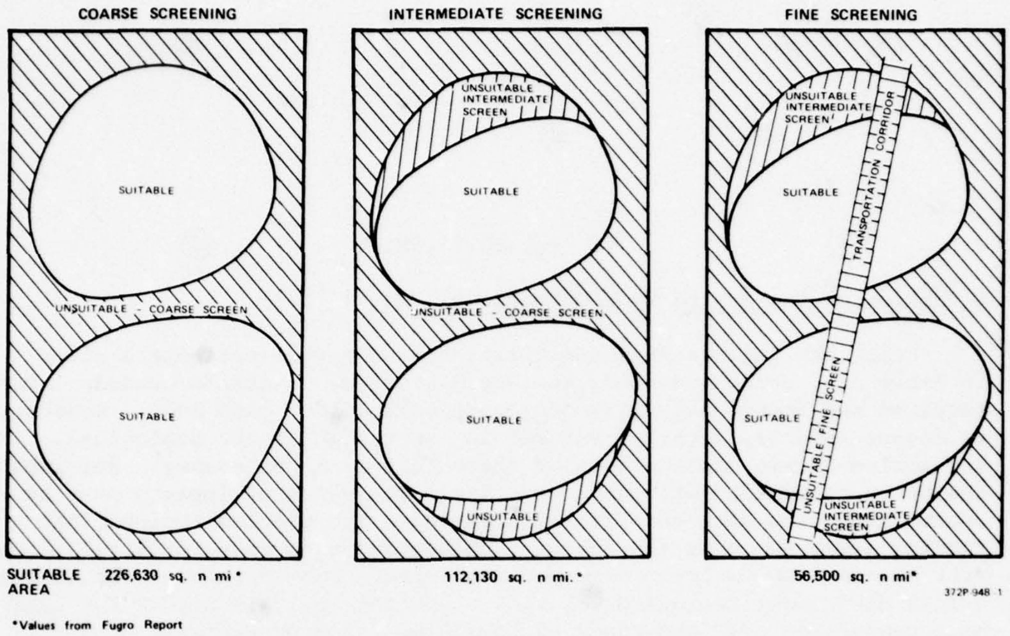


Figure 1-7. Schematic representation of suitability screening results.

Intermediate screening added topographic, e.g., elimination of areas having drainage densities averaging at least two 10-ft deep (3 m) drainages per 1,000 ft (305 m), and more stringent cultural, e.g., high potential economic resource area criteria. This reduced the recommended suitable area to 112,130 sq nmi (384,500 km^2) located as shown in Figure 1-8. Intermediate screening criteria are given in Table 1-2.

Fine screening excluded areas that had other uses that would significantly increase costs or system complexity. This screening did not result in any major land exclusions, rather it demonstrated the amount of fragmentation of suitable parcels (intermediate polygons) that occurred by identifying restricted use areas due to utility corridors (roads, energy, or water conveyance systems, etc.). The suitable area remaining after this screening was 56,500 sq nmi (193,740 km^2). Fine screening criteria are given in Table 1-3.

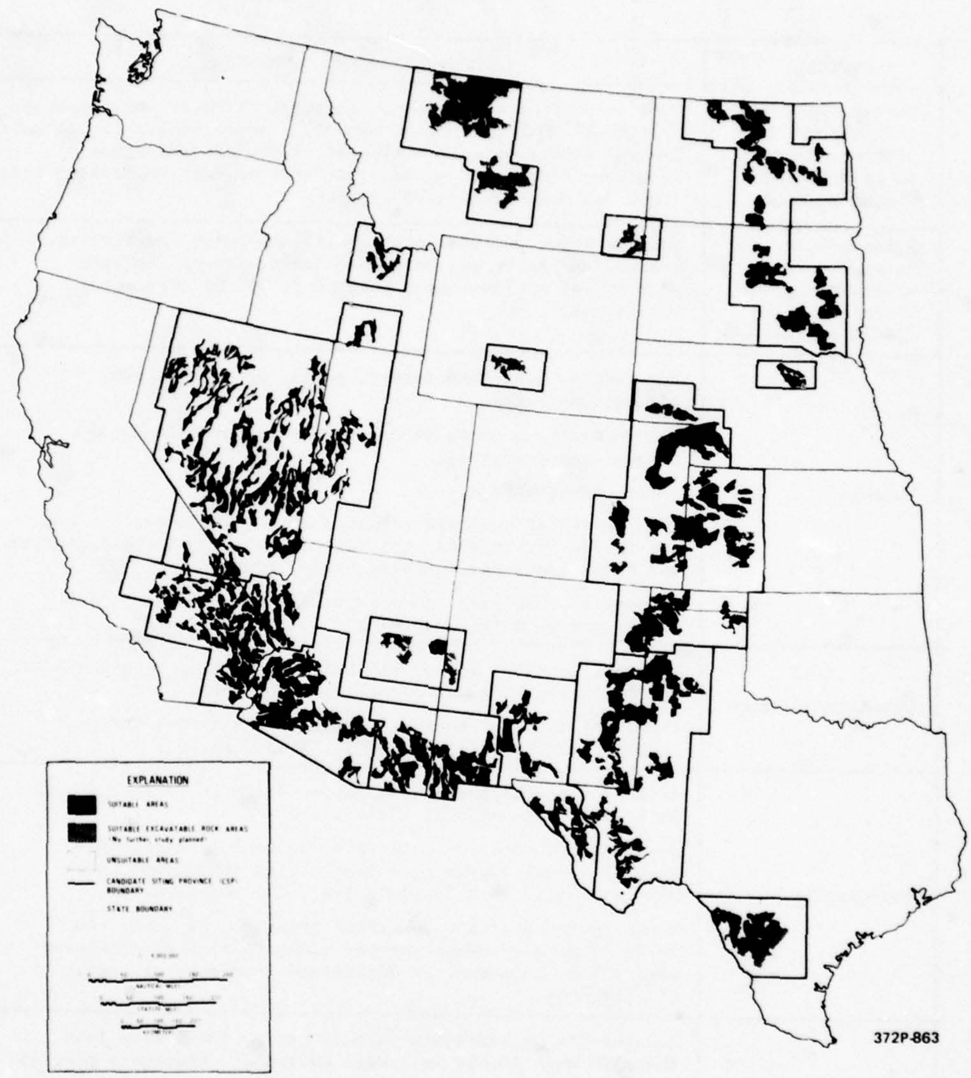


Figure 1-8. Areas geotechnically suitable for deployment of MX. Solid areas are suitable for either trenches or shelters. Cross-hatched areas are suitable for all basing mode options but would require extensive excavation of rock.

Table 1-2. Screening criteria for determining areas geotechnically suitable for MAP trench or shelter deployment.

CRITERIA	DEFINITION AND COMMENTS
Surface Rock and Rock occurring within a Nominal 50 ft (15 m) of Ground Surface	Rock is defined as any earth material which is not rippable by conventional excavation methods. Where available, seismic P-wave velocities were evaluated in the determination of rock conditions. In general, seismic velocities greater than 7,000 FPS were considered as rock.
Surface Water and Water occurring within a Nominal 50 ft (15 m) of Ground Surface	Surface water includes all significant lakes, reservoirs, swamps, and major perennial drainages. Depths to water of confined aquifers more than 50 ft (15 m) were not considered.
Cultural	All federal and state forest, parks, monuments, and recreational areas. All federal and state wildlife refuges, grasslands, ranges, and preserves. Indian reservations. High potential economic resource areas, including oil and gas fields, strippable coal, oil shale and uranium deposits, and known geothermal resource areas (KGRAs). Industrial complexes, such as active mining areas, tank farms, and pipeline complexes.
Quantity/Distance	Eighteen nautical mi (33 km) exclusion radius from cities having populations (1970) of 25,000 or more. Three nmi (5.5 km) exclusion radius from cities having populations (1970) of between 5,000 and 25,000.
Topographic	Areas having surface gradients exceeding 10 percent as determined from maps at scale 1:250,000. Areas of characteristic terrain, defined by a preponderance of slopes exceeding 5 percent, as determined from maps at scales of 1:250,000, 1:62,500, and 1:24,000. Areas having drainage densities averaging at least two 10-ft (3 m) deep drainages per 1,000 ft (305 m) (measured parallel to contours, as determined from maps at scales of 1:24,000).
Minimum Area (Secondary Criteria)	All parcels or aggregate parcels having total area less than 500 nmi^2 (1,714 km^2) were excluded. Aggregate parcels must be a minimum of 150 nmi^2 (514 km^2) to be included in the aggregate total and must not be isolated from adjacent suitable parcels by distances greater than 10 nmi (18 km) or by grades greater than 10 percent. Individual parcels may be further reduced in area if the combined or individual alignment of county, state, and federal paved highways, railroads, aqueducts, or perennial streams is sufficiently dense to restrict the emplacement of a straight 10 nmi (18 km) trench.

372T-4001

Table 1-3. Fine screening criteria.

FNI REFERENCE NUMBER	CRITERIA	DEFINITIONS
FS-1	Military Bases/Missile Sites	1 nmi (nautical mile) (1.8 km) from boundaries of all military bases and missile sites
FS-2	Electrical Transmission Lines	1 nmi (1.8 km) from boundaries of all major buried and surface electrical transmission lines (≥ 115 kV)
FS-3	Communication Lines	1 nmi (1.8 km) from boundaries of all major buried and surface communication lines
FS-4	Oil and Gas Pipelines	1 nmi (1.8 km) from boundaries of all major buried and surface oil and gas pipelines (≥ 4 inch (10 cm) diameter)
FS-5	Mineral Deposits, Mining Distribution Areas, Oil and Gas Fields	1 nmi (1.8 km) from boundaries of all economically important mineral deposits, mining, distribution, and oil and gas fields
FS-6	Highways, Railroads	1 nmi (1.8 km) from boundaries of all major state and federal paved highways, and railroads
FS-7	Cultural Land Use	1 nmi (1.8 km) from boundaries of all state and federal parks, momuments, forests, grasslands; historic sites; game preserves and refuges; Indian reservations, and public lands set aside to preserve areas with unique recreational, historical, and natural values
FS-8	International Borders	5 nmi (9 km) from boundaries of international borders
FS-9	Communities	1 nmi (1.8 km) from boundaries of all communities with populations less than 5,000
FS-10	Large Energy/Water Projects	1 nmi (1.8 km) from the boundaries of all large energy or water conveyance projects (e.g., known geothermal resource areas/major canals and aqueducts)

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BMCA Region Selection Procedure (1.2.1.2). Most of the geotechnically suitable areas for MX deployment fall into seven physical-biological regions (see Figure 1-9). These are:

(1) The Great Basin Desert

(2) The Mojave Desert

(3) The Sonoran Desert

(4) The New Mexican Semidesert Grassland

(5) The Trans-Pecos Chihuahuan Steppe

(6) The High Plains

(7) The Southern Great Plains

The physical-biological regions, or provinces, each have a distinct physical character in terms of topography, soils, and weather. This results in a distinct biological character with its own assemblage of plants, animals and ecosystem characteristics. Thus, prevailing physical and biological characteristics that would influence the project or determine the degree of environmental impacts of the different basing modes tend to be relatively similar throughout each region. Tables 1-4 and 1-5 compare the BMCAs with respect to environmentally significant physical and biological features. Two things are immediately apparent: the great region-to-region variability in most of these characteristics, and the complexity of their variation. The region-to-region variation in physical and biological characteristics largely encompasses the range of characteristics that would be encountered by MX deployment in any geotechnically suitable area. Urban socioeconomic characteristics may not depend on these regional characteristics. However, urban concentrations have already been eliminated in the geotechnical screening. The remaining rural and semi-rural socioeconomical character is largely influenced by the physical-biological regime (see Table 1-6). As a result, selecting one example from each of the seven regions should cover most of the possibilities pertinent to comparing the environmental impacts associated with the different possible MX Basing Modes.

The BMCAs used as sample site locations for analysis, were then selected by picking geotechnically suitable parcels in each region as shown in Figure 1-9. As this figure indicates, the BMCAs impinge at least partly on Arizona, California, Colorado, Kansas, Nebraska, Nevada, New Mexico, Texas, Utah and Oklahoma.

MAP Land Use - Security Control. 1.2.1.3. Three useful land classifications describing land use and control are:

- Deployment Area
- Fenced Area
- Safety Area

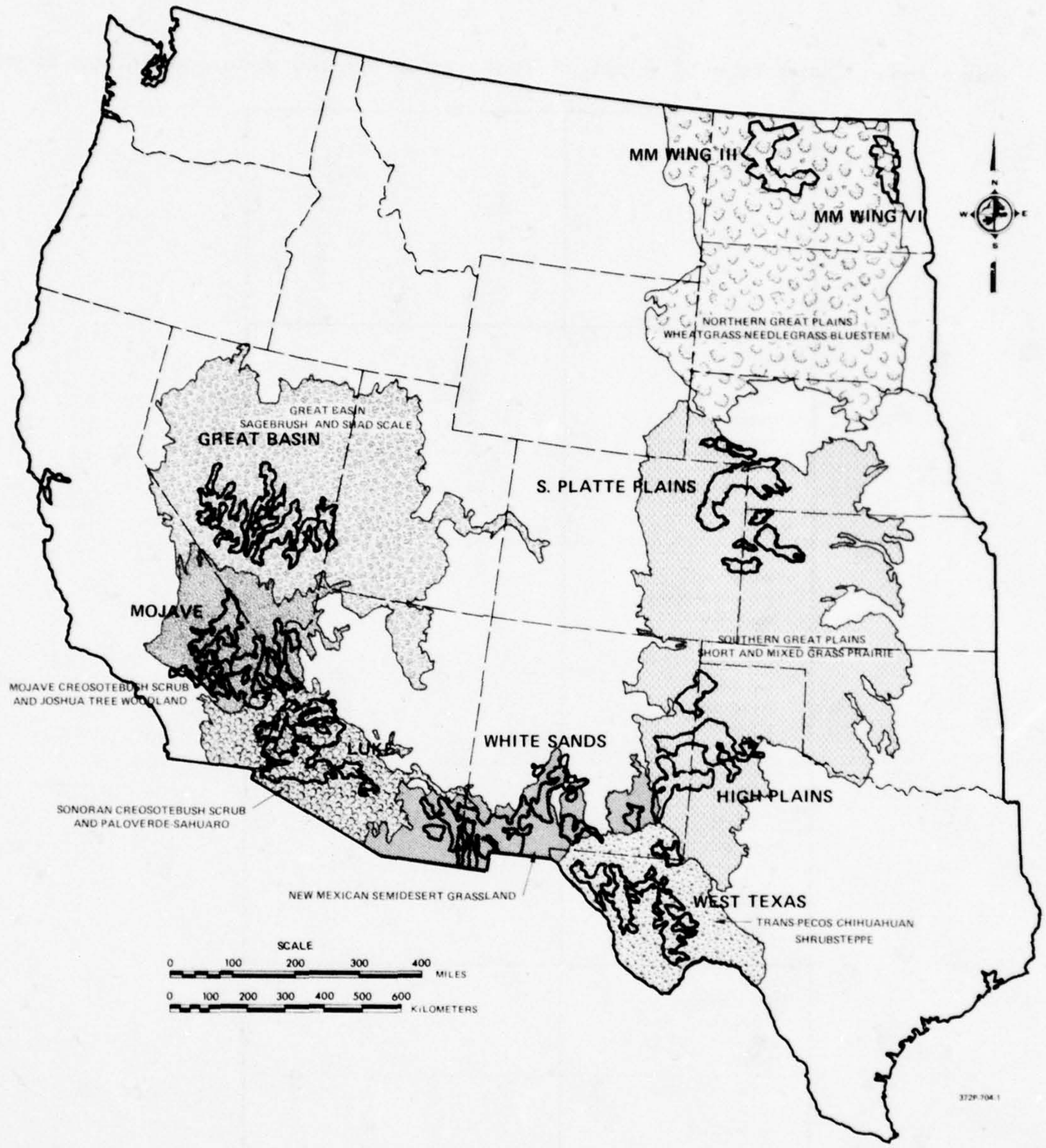

Figure 1-9.. Physical-biological regions within the areas geotechnically suitable for MX deployment. Boundaries of vegetation types are from Kuchler (1964; 1966). Nonstandard names used for certain regional types reflect aggregations of co-occurring regional vegetation types (e.g., Great Basin Sagebrush and Shadscale) made for the purposes of this study.

Table 1-4. Comparison of physical features of basing mode comparison areas.

PHYSICAL FEATURES	CENTRAL NEVADA	CALIF. MOJAVE DESERT	LUKE	WHITE SANDS	WEST TEXAS	TEXAS/NEW MEXICO HIGH PLAINS	SOUTH PLATTE PLAINS	NORTHERN BASING
GEOLOGY								
Topography								
High Relief	XX	XX	X	X	X			
Slopes > 10%	X	X	X	X	X			
Drainage Crossings	XX	XX	XX	X	X			
Stratigraphy								
Post-Tertiary	X	X	XX	XX	X	XX	X	XX
Tertiary	XX	XX	X	X	X	X	XX	XX
Pre-Tertiary	XX	XX	X	X	XX			
Soils								
Agricultural			X	X	X	XX	XX	XX
Highly Wind Erodable						X	X	X
Shrink/Swell						X	X	XX
Presence of Boulders								X
Free-Standing Capability	X	X	X	XX	XX			
Seismic Risks								
Ground Rupture	X	X						
Liquefaction				X		X	X	X
Ground Motion > 5% g	XX	X	X	X	X			
Paleontology (Disturbance)								
Invertebrate Fossils	X	XX	X	X	X			
Vertebrate Fossils		X		X			X	
Mining Activities								
Metallics	X	X	X		X			
Non-metallics	X	X	X	X	X	X		X
Oil/Gas					X	XX	X	X
Coal								X
Geothermal	X	X		X				
HYDROLOGY								
Surface Hydrology								
Flash Flood Potential		X	X	X	XX	X		X
Steep Watershed Gradient	X		X	X	X	X		
Sedimentation					X		X	X
Groundwater Hydrology								
Current								
Overdrafting		X	X	X	X	XX	X	
Subsidence			X		X	XX	X	
High Salinity/Hardness	X	X	XX		X	XX		
METEOROLOGY								
Climate								
Summer Dominant Precipitation					X	X	X	
Winter Dominant Precipitation	X	X						
Bi-Seasonal Precipitation			X	X				X
Annual Snow Depth > 24"	X					X	X	XX
Air Quality								
Dust	X		X	X	X		X	
High Pollution Potential		X	X	X	X			
Hazardous Weather								
Tornadoes						X	X	
Winter Storms				X	X	X	X	X

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Table 1-5. Comparison of biological features of basing mode comparison areas.

BIOLOGICAL FEATURES	BASING MODE COMPARISON AREAS						
	CENTRAL NEVADA	CALIF. MOJAVE DESERT	LUKE	WHITE SANDS	WEST TEXAS	TEX/NM HIGH PLAINS	SOUTH PLATTE PLAINS
TERRESTRIAL BIOLOGY							
Large Areas of Undisturbed Habitat	XX	XX	XX	X	X		
Grazing Use of Lands	X			X	XX	X	XX
Extensive Croplands							
Irrigated			X	X		XX	X
Non-irrigated						X	XX
Off-road Vehicle Use	X	XX	X				
Rapid Habitat Recovery and Revegetation of Cleared Areas	X			X	X	XX	XX
Diverse Habitats		X		XX	XX		
Special or Restricted Habitats	X	X		X	X		X
Animal Diversity							
Mammals	X	X	XX	X	XX		
Birds			X	XX	XX	X	X
Reptiles and Amphibians	X	X	X	XX	XX		
Ecologically Important Populations of Non-weedy Annual Plants	X	XX	X				
Large Grassland Areas				X	X	X	X
Riparian Vegetation Important				X	X		XX
Important Game Animal Populations	X	X		X	X		
Perennial Plant Species Diversity			XX	X	XX		
Annual Plant Species Diversity	X	XX	X				
High Plant Growth Form Diversity		X	XX	X	X		
Primary Productivity				X	X	XX	XX
Dry Wash Vegetation Important	X	XX	XX	X	X		
Large Areas of Desert Pavement	X	X	XX				
AQUATIC BIOLOGY							
Important Habitats							
Lakes, Ponds, Impoundments					X	X	X
Playas	XX	X		X		XX	
Rivers, Large Streams—Permanent		X	X	X	XX	X	X
Rivers, Large Streams—Ephemeral		X	X	X	X		
Springs, Seeps	X	X		X	X	X	
Silt Concentrations				X	X		XX
Endemic Fish Fauna	XX	XX		X	X	X	
Important Waterfowl Migratory Routes		X	X	X		XX	XX
Important Sport Fisheries		X	X	X	X	X	XX
Fish Diversity				X	X		XX
PROTECTED SPECIES							
Endangered or Threatened Mammals			XX	X	X	X	X
Endangered or Threatened Birds—Breeding		X	X	XX			X
Endangered or Threatened Birds—Migratory Only	X	X	X	XX	X	X	X
Endangered or Threatened Reptiles and Amphibians			X	X	XX	X	
Endangered or Threatened Fishes	XX	XX	X	X	X	X	
Endangered Invertebrates				X			
Candidate Endangered or Treatened Plants	X	X			XX		

372T-4018

Table 1-6. Comparison of socioeconomic features of the basing mode comparison areas.

SOCIOECONOMIC FEATURES	CENTRAL NEVADA	CALIFORNIA-MOJAVE	LUKE	WHITE SANDS	WEST TEXAS	TEXAS HIGH PLAINS	SOUTH PLATTE PLAINS
High Value of Agricultural Output			X			XX	XX
Important Irrigated Agriculture			X			XX	XX
High Proportion of Land in Private Ownership					XX	XX	XX
High Rural Population Density						X	X
Rapid Population Growth		X	XX				
Declining Population	X				X	X	X
Large Unemployed Labor Force		XX	XX				
Low Accessibility	XX	X	X	X	X		
Highly Articulated Transportation Network						XX	X
Deficient Electric Generating Capacity					XX	X	
Important Potential Archaeological Resources	X	X	X	XX	X		

372T-4019

X = Moderately true of area

XX = Especially true of area.

Deployment Area relates to a given force element and is the total geographic area, suitable and unsuitable, bounded by a simple figure enclosing the force element of interest. There are other regions of interest, e.g., biological and socioeconomic regions.

Fenced Area is the area included within the fence and controlled by the Air Force. Fenced areas were formerly known as exclosion areas. Like the deployment area, they relate to a given force element and can include some geotechnically unsuitable areas.

Safety Area, formerly known as easement area, is the area that must be restricted in use, e.g., no inhabited dwellings because of the explosive quantity distance considerations given in AF Regulations 127-100, Explosive Safety Standards. Safety Area can be used for roads, farming, grazing, etc. Again, like the deployment area, it is related to a given force element.

Fenced areas will be radically different sizes for point and area security and this constitutes a major and important difference between these two security configurations. As rough first approximation, geographic deployment regions will be the same for both point and area security. However, if aimpoints are adjusted for minimum impact in the point security configuration, e.g., minimize necessity for people moving, the point security mode may have a bigger deployment area than the area security mode. Safety areas will only apply to point security, since it is expected they will be included inside the fenced areas for area security.

A graphic representation of point and area security land use for two fine screened parcels is given in Figure 1-10.

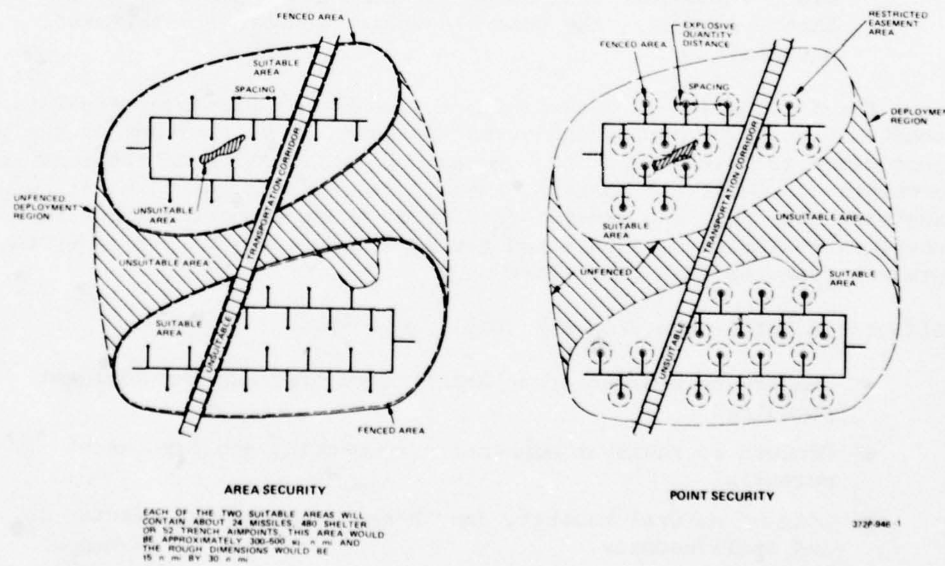

Figure 1-10. Alternative security configurations.

Size of the safety, fenced, and deployment areas for the basing mode configurations considered are given in Section 3.

Key Issues (1.2.2)

Initial examination of all basing modes showed a qualitative similarity in the kinds of action associated with deployment. These include:

- Existence of the system within a total area (deployment area)
- Exclusion from alternative uses of fenced areas
- Disturbance of surface
- Utilization of construction materials, water, and energy resources, and
- Utilization of labor.

These factors—the interface between the engineering configuration and the environmental changes—are defined as primary factors. The absolute magnitudes of each of these factors are generally large and each would be expected to cause noticeable environmental changes at most project sites.

The questions then become:

- What specific environmental variables are changed by primary factors of this magnitude? and,
- What environmental variables are most likely to be considered adequate indices of environmental change by regulatory agencies, the general public, and other interested parties?

The first stage in determining environmental variables consists of constructing brief deployment scenarios based on a knowledge of the project sites to be sure that the general characteristics of the impacts are understood. Section 3 contains summary diagrams in the forms of network analyses that show the general results of these scenarios. The key environmental variables selected for impact analysis listed under the project features that cause them are:

Effects of Total-Area Presence (Deployment Area)

- Concern by resident population respecting nuclear accident potential
- Concern by resident population respecting nuclear target potential
- Loss of natural habitat, and threat to protected plants and small mammals

Effects of Fenced-Area Control

- Interference with existing military, agricultural, or commercial use of the land causing loss of jobs and revenue.
- Dsplacement of inhabitants and elimination of recreation from the land for the life of the project.
- Potential exclusion of big game mammals from winter forage and breeding grounds (area security).

Effects of Surface Disturbance

- Loss of archaeological artifacts
- Loss of threatened or endangered species or interference with their critical habitat
- Degradation of visibility from increased dust
- Loss of natural character from changes in vegetation, drainage patterns (erosion), and permanent alteration of surface features such as desert pavement.

Effects of Resource Consumption

- Cement requirements could be large enough to cause shortages to other users.
- Water requirements could decrease water table enough to cause wells and springs to go dry, threaten protected aquatic species
- Electrical energy requirements could necessitate construction of additional generating facilities.

Effects of Direct Employment

- Local and regional employment will increase offsetting any loss of jobs from exclusion from the land, but potentially diverting workers from other occupations.
- Large numbers of people may migrate into the project area potentially overloading services (such as schools, police protection) and requiring greater expenditures of public (tax) dollars.
- New housing and support facilities will be required providing jobs, but using up land.
- Highways will become more congested.
- Increased noise, dust, and exhaust emissions will accompany the increased traffic.

The BMCA Environment (1.2.3)

The environment is described for the selected Basing Mode Comparison Areas in the following section.

Central Nevada Great Basin BMCA (1.2.3.1). The Central Nevada Great Basin BMCA was selected as a sample of the geotechnically suitable areas in the Great Basin Desert. Figure 1-11 shows this sample area as well as other geotechnically suitable areas nearby. The outlined areas representing the BMCA contain approximately 6,300 mi^2 (16,400 km^2). This is the estimated area required for area security deployment in nominal spacing of 175 missiles in buried trenches, 195 in horizontal shelters, 170 in vertical shelters, and 195 in pools. In expanded spacing, 110 missiles in trenches, 65 in horizontal shelters, 60 in vertical shelters and 65 in pool could be accomodated. The differences between modes depend on the nominal spacings (Table 1-1) and the unsuitability of about 40 percent of the area for vertical shelters due to greater depth of the vertical shelters below the surface. Transportation and utility corridors are not shown but have been accounted for in numbers deployed. The outlined areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

Geologic Environment (1.2.3.1.1)

- Typical basin and range geomorphology, exhibiting hardrock ridges and intermontane basin-fill.
- Topographically suitable areas are long north-south trending alluvial valleys separated by block-faulted mountain ranges rising, on the average, 3.500 ft (1,067 m) above valley floors. In the southern part of the BMCA, valleys are elliptical and separated by low mountains.
- Valleys dominated by alluvial fans with hardrock pediments probably commonly occurring at shallow depths beneath the fans near the mountains. Inseibergs are commons.
- Drainage in the BMCA is almost completely internal. Stonewall Flat, Ralston Valley, Cactus Flat, Gold Flat, Stone Cabin Valley, Kawich Valley, and Railroad Valley are closed basins with drainage terminating in a playa or series of playas. The remaining valleys drain into these closed basins.
- Water erosion is the most important modifier of surface forms with wind erosion being important on playas.
- Windblown sand sheets and active and stabilized dunes have a localized occurrence in Railroad and Reveille valleys.

- Paleozoic meta-sedimentary rocks and Mesozoic granitics dominate the landscape; Tertiary volcanics are important in the southern part of the BMCAs. Quarternary volcanics have local occurrence.
- Most alluvial material and playa deposits are late Quaternary or Holocene in age. Older basin-fill deposits range into Plio-Pleistocene.
- Soils are variable: generally clayey and silty, tending to be saline or alkaline in the valley bottoms, and coarse, sandy and rocky on the alluvial fans. Most have limited agricultural potential.
- Faults mostly active during late Tertiary and Quaternary times parallel most of the north-south mountain ranges. Some relatively recent, possibly Holocene, volcanic activity in the area.

Mineral Resources (1.2.3.1.2)

- Metal mining in the area but activity has declined.
- Abundant evaporite deposits associated with playas.
- Railroad Valley produces the only oil in Nevada (estimated production, 1970-1980, is 150,000 barrels [23,850 m^3].
- Potential geothermal resources.
- Sand and gravel deposits readily available in most valleys.

Surface Hydrology (1.2.3.1.3)

- Eight in. (20 cm) average annual precipitation; estimated annual runoff 0.1 in. (0.25 cm).
- One-hundred year flood peaks, 6,400 and 10,000 cfs (419 and 283 m^3) for 50 and 100 mi^2 (129.5 and 259 km^2).
- Essentially no perennial water in the area.

Groundwater Hydrology (1.2.3.1.4)

- Major aquifers are alluvial deposits and carbonate rocks.
- Fresh to moderately saline waters available in areas away from playas.
- Up to 50 million acre-feet (62 x $10^9 m^3$) of groundwater may be stored in the upper 100 ft (30 m) of valley-fill in the BMCA.

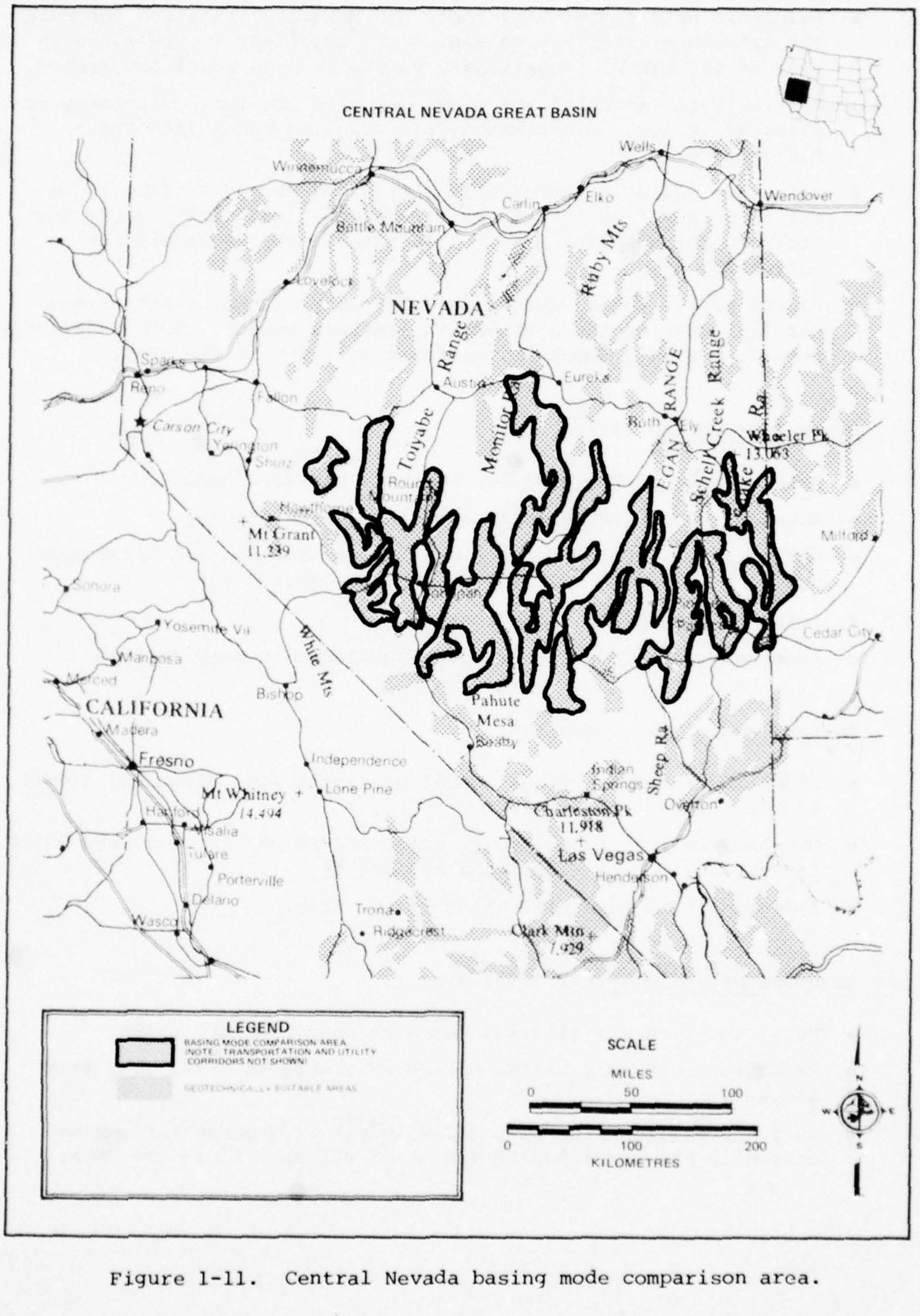

Figure 1-11. Central Nevada basing mode comparison area.

Meteorology (1.2.3.1.5)

- Desert climate with hot summers, mild winters, and a wide range of extremes due to mountain effects.
- Precipitation is associated mainly with summer thunderstorms and winter storm systems originating off Mexico's west coast.
- Wind flow tends to be oriented along the north-south mountain ranges and averages about 10 knots (0.3 km/hr) annually.
- Dust storms occur with dry winter cold fronts and are occasionally severe.
- Poor dispersion conditions occur frequently with light winds and mixing depths tend to lie below the lower mountain tops and trap pollutants in the valleys.

Air Quality (1.2.3.1.6)

- Twenty-four hour particulate levels exceed national standards frequently; ozone, sulfur dioxide and nitrogen dioxide levels exceed standards only rarely; and carbon monoxide levels remained below standards at all stations.
- Only one Mandatory Class I Air Quality Area (no degradation permitted) Jarbridge National Wilderness Area, has been identified in Nevada, and it lies over 50 mi (81 km) from the BMCA boundary.

Terrestrial Biology (1.2.3.1.7)

- Typical Great Basin Desert scrub vegetation dominated by shrubs of uniform height.
- Lower plant species richness and growth form; less diversity than other Intermontane Division BMCAs (i.e., California Mojave, Luke/Yuma, White Sands, West Texas-Rio Grande).
- Higher than average diversity in southern-most portions of the BMCA because of transition to Mojave Desert vegetation.
- Low human disturbance. Little cultivated land within the BMCA but some to the east and to the north. Major disturbance is grazing by cattle, wild horses and burros which has changed plant species composition within historical times, with shrubs increasing over grasses.
- Areas of crested wheat-grass planting to improve range in northern portions of BMCA.

- Primary factors in plant distribution are mosaic of contrasting soil parent materials (volcanic vs. carbonate rock) and topographically controlled salinity/soil textural gradients from upper bajadas to playas.
- Two major vegetation types: sagebrush scrub on upper bajadas, higher elevations and to the north and shadscale scrub on finer soils, lower elevations and toward the southwest.
- Sagebrush scrub may interdigitate deeply in shadscale along major arroyos. In southwestern portion there is an intermixture of creosote bush and Joshua tree along lower shoulders of some bajadas.
- Local occurrence of halophytic (salt-tolerant) and/or phreatophytic (requiring groundwater) vegetation around playa margins and on raised soil deposits on playa bottoms.
- Vegetative recovery rate is slow, but probably more rapid than the more southern deserts that have more long-lived arborescent species.
- Fauna relatively simple. Nocturnal rodents important. Birds, reptiles, and amphibians less rich in species than other Intermontane Division BMCAs.
- The BMCA lies along a north-south faunal transition, especially the southern-most portions. Faunas with both northern and southern (Great Basin and Mojave) affinities interdigitate in the region. In some valleys closely related species pairs may be found in the same locality; i.e., southern grasshopper mouse (Onychomys torridus) and northern grasshopper mouse (O. leucoguster).
  - Reductions in reptile diversity associated with relatively low mean annual temperatures and generally simpler habitat structure which results in a less diverse resource base.
  - General aridity, lack of summer rains and isolation from colonizing sources are largely responsible for low amphibian diversity in many of the valleys of the BMCA. Only a few species have been introduced or have survived in isolated springs and small streams as aridity has increased since the last glacial period.

<u>Aquatic Biology</u> (1.2.3.8)

- The ephemeral nature and salinity/alkalinity of waters limit development of aquatic biota.

- The only major impoundment is the Adams McGill Reservoir on the White River.
- Besides the White River there are a few perennial streams (Hot Creek) and springs (Warm Springs) and many playas (Mud Lake in Ralston Valley).
- Many of the perennial streams and springs especially in the eastern part of the BMCA have endemic, thermal-and salt-tolerant fish with restricted distributions.
- The protected Pahranagat bonytail and the Railroad Valley springfish are found in hot springs while the spring-fed White River is the habitat of the threatened White River springfish, White River spinedace and White River sucker. An uncommon minnow, Gila biolor, is also found here.
- Lowering groundwater level could seriously affect these endangered and threatened fish.

Protected Species (1.2.3.1.9)

- The endangered Pahranagat bonytail, a federally protected fish species, occurs in the BMCA.
- The White River springfish, White River spinedace, White River sucker, and Railroad Valley springfish are considered threatened species by the State of Nevada and are present in the BMCA.
- Approximately seven proposed endangered plant species (Federal Register 6/16/76) and an additional twenty-four species under review as Threatened Species (Federal Register, 7/1/75) occur in or near the Central Nevada Great Basin BMCA. Most of these species are concentrated in the southern part of the BMCA and tend to be localized in unusual soil or rock situations.

Economy (1.2.3.1.10) Table 1-7

- Economic Effects Province economy dominated by Clark County (Las Vegas) and Washoe County (Reno).
- Recreation as a tourist-related economic activity is crucial to the economy; about half of employment is in the Trade and Services industry, compared to 32 percent in the U.S. economy.
- Economic growth was rapid during 1967-70, and accelerated from 1970 to 1975.
- Per capita income well above national average.
- Immediate BMCA counties, in contrast to Clark and Washoe

Counties are among the least developed in the nation; dependent on low levels of extensive agriculture and mining for income and employment; federal employment is disproportionately large.

- The value of agricultural products sold in 1974 averaged \$200 per mi^2.

Social Environment (1.2.3.1.11)

- Population of the BMCA counties (Esmeralda, Lander, Lincoln, Mineral, Nye and White Pine) was about 30,200 in 1975; about one third of this total resided in White Pine County which contains the city of Ely. The overall density of these counties was 0.6 persons per mi^2, and the rural density was 0.5 persons per mi^2.
- Median level of education completed by adults in BMCA counties is just over 12 years.
- Occupancy of dwelling units varies from about 60 percent in Esmeralda County to 95 percent in White Pine County.

Community Infrastructure (1.2.3.1.12)

- Electric generating capacity in Nevada grew 10.4 percent per year between 1965 and 1975; production increased at 14.5 percent rate; less than one-fifth of production is from hydroelectric sources. The western systems coordinating council projects a 7,000 to 19,500 mw surplus generating capacity in this region in 1986 (DOE, 1978).
- Existing water supply limits may restrict future growth because surface and groundwater supplies are meager. Future allocations of Colorado River Water are expected to be used in Clark County (Las Vegas).
- Only Interstate Highway 80 serves the BMCA counties and this is located in the northerly part of Lander County. Deficiency in nonfederal and state aid highways has become acute, and generally highway access to the BMCA counties is limited.

Cultural Resources (1.2.3.1.13)

- Ten archaeological site types expected to occur. High site potential for lithic scatters, campsites, ceramic scatters, rock features, rock alignment features, rock shelters and rock art.

Table 1-7. Central Nevada Great Basin BMCA economic effects province* historic income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	1,645.2	1,943.5	2,702.0
	Per Capita Income[2]	3,417	3,675	4,205
	Relative Per Capita Income[3]	1.07	1.12	1.11
Earnings[1]	Total	1,412.0	1,663.8	2,026.0
	Farm	25.4	36.6	35.0
	Private Nonfarm	1,122.6	1,307.3	1,670.2
	Federal Government	116.7	140.7	162.0
	State and Local Government	148.3	179.2	258.8
Employment[4]	Total	212,830	257,237	312,868
	Farm	6,415	6,346	6,211
	Private Nonfarm	164,915	200,374	246,930
	Government	41,500	50,617	59,627
Labor Force and Unemployment[5]	Civilian Labor Force	NA	218,300	288,400
	Unemployment	NA	12,800	27,800
	Unemployment Rate (percent)	NA	5.9	9.6

372T-4002

[1]Millions of 1967 dollars.

[2]1967 dollars.

[3]Area per capita divided by national per capita.

[4]Number of jobs.

[5]Annual Average.

Source: Bureau of Economic Analysis, 1977; Nevada Employment Security Department, 1978.

*The economic effects province is composed of Bureau of Economic Analysis economic areas 160 and 161, comprising all of Nevada.

- Areas with high archaeological site potential are springs, playas, strand lines, ridges and rock outcrops.
- Only about 1 percent of state of Nevada has been surveyed by archaeologists.

California Mojave Desert BMCA (1.2.3.2). The California Mojave Desert BMCA was chosen as a sample of the geotechnically suitable areas in the Mojave Desert. Figure 1-12 shows this sample area as well as other geotechnically suitable areas nearby. The outlined areas on the figure representing the BMCA, contain approximately 6,400 square miles (10,300 km^2). This is the estimated area required for nominal spacing area security deployment of 180 missiles in buried trenches, 200 in horizontal shelters, 260 in vertical shelters and 195 in pools. In expanded spacing 110 missiles in trenches, 65 in horizontal shelters, 90 in vertical shelters and 70 in pools could be accommodated. The differences between modes depend on the nominal spacings (Table 1-1) and the unsuitability of about 10 percent of the area for vertical shelters due to greater depth of the vertical shelters below the surface. Transportation and utility corridors are not shown but have been accounted for in numbers deployed. The outlined areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

Geologic Environment (1.2.3.2.1)

- Landforms are typical basin and range but with less linear regularity of pattern and much greater occurrence of crystalline intrusive igneous rocks and metamorphic rocks.
- Basins are broad and are composed of pediments (near-surface planed bedrock) near the mountains, coalesced alluvial fans and playa deposits; local relief and ratio of bedrock area to valley-fill area increases to the east.
- Wind and water erosion are both active in the BMCA and areas where desert pavement or vegetation have been disrupted are subject to severe erosion.
- Tectonic activity has exposes formations ranging from Precambrian schists to Quaternary alluvium; bedrock geology is extremely varied in age and rock type. Most topographically suitable areas are on Pleistocene fanglomerates, valley alluvium, and playa deposits.
- Soils are extremely variable; some valley alluvial soils given suitable quality irrigation water and fertilization are very productive with alfalfa. This is the predominant crop in the

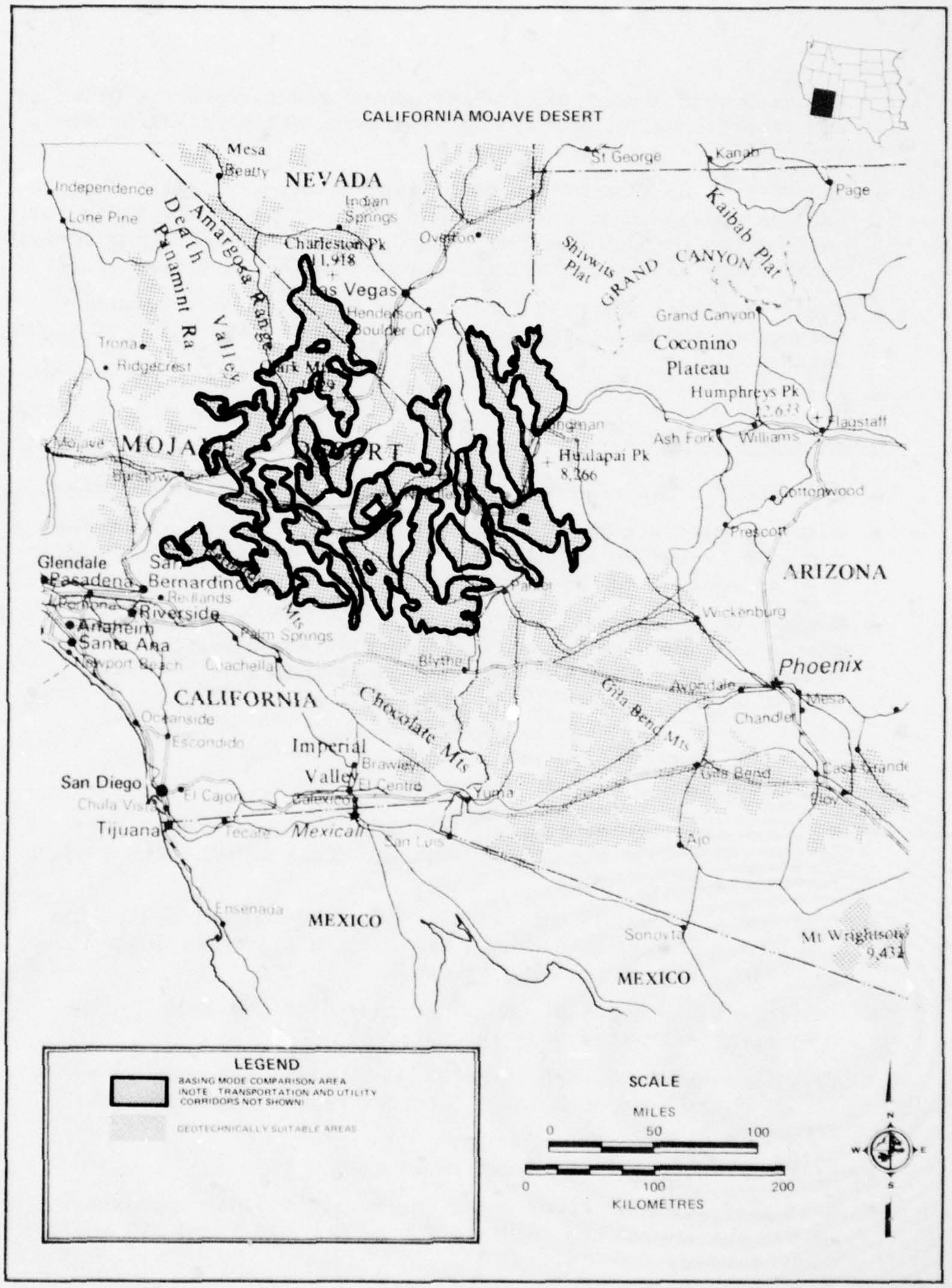

Figure 1-12. California Mojave Desert basing mode comparison area.

Mojave Desert proper and a multitude of truck crops are grown in the Imperial Valley. Playa soils are too saline/alkaline for agriculture.

- The BMCA is bounded by two major active fault systems: The Garlock and San Andreas faults. Subsidiary faults of these two systems run through the BMCA; abundant evidence shows the activity of these faults during Pleistocene and recent times.
- There is rather abundant Pleistocene and Holocene volcanism throughout the BMCA; Pisgah and Amboy craters are dated at 6,000 years B.C.

Mineral Resources (1.2.3.2.2)

- Non-metallic minerals and rock are actively mined in the area.
- Metallic minerals have been mined historically but except for tungsten, reserves are too low for economically feasible extraction in most of the known deposits.
- Sources of aggregate are abundant in the BMCA and limestone mining for concrete accounts for half of the dollar value of mining production in the BMCA, however, information is not yet available on extent of these reserves.

Surface Hydrology (1.2.3.2.3)

- No perennial streams in the BMCA; drainage is internal into playas throughout the BMCA except for areas immediately adjacent to the Colorado River.
- Drainage pattern is radially away from the mountains with the numerous dry washes running directly into playas or coalescing in valleys before reaching playas.
- Salton Sea, adjacent to the southern end of the BMCA, is the only permanent water body in the area.
- This is overall the driest BMCA; precipitation ranges from 2-3 in. (5-7 cm) to 6 or 8 in. (15 to 20 cm) with long droughts frequent.
- Average runoff 0.25 in./year (6.25 mm/year).
- Estimated 100-year flood peaks for 50 and 100 mi^2 approximate 14,800 and 26,000 cfs (419 and 736 m^3 per 129.5 and 259 km^2), respectively.
- Surface water supply insignificant.

Groundwater Hydrology (1.2.3.2.4)

- Major source of groundwater is unconsolidated basin-fill deposits.
- Depth to groundwater extremely variable but may be as shallow as 10 ft (3 m) in bottoms of some topographically suitable valleys and is commonly less than 50 ft (15 m).
- Local subsidence in part of the BMCA has been attributed to groundwater withdrawal.
- Stored groundwater estimated at 100 million acre-feet (123×10^9 m^3) but extensive withdrawals will have significant hydrologic effects.

Meteorology (1.2.3.2.5)

- Hot summers with mild pleasant winters and a large percentage of available sunshine.
- Precipitation is light and spread throughout the year with a slight tendency to be higher in winter although thunderstorms contribute to a measurable peak in July and August for some locations.
- The winter season is characterized by the passage of weak frontal systems that produce winds and little precipitation.
- Winds occur predominately from the west and southwest over the area with speeds occasionally up to 45 knots (85 km/hr) in winter.
- Dust and sandstorms occur with the stronger winds.
- Poor dispersion conditions occur frequently during periods of shallow mixing depth and low wind speed.

Air Quality (1.2.3.2.6)

- Twenty-four hour particulate levels frequently exceed national standards in parts of the BMCA. Ozone levels rarely exceed standards with one exceptional location while sulfur dioxide, nitrogen dioxide, and carbon monoxide levels remained below standards.
- Two Mandatory Class I Areas (no degradation permitted) lie within 50 mi (81 km) of the BMCA boundary; Sequoia National Park and San Gabriel National Wilderness Area.

Terrestrial Biology (1.2.3.2.7)

- Vegetation is predominantly a simple community dominated by two shrubs, creosote bush and white bursage communities with diversity increasing at the bases of mountains. Different simple specialized communities occur around playas where salinity and fine soil texture inhibit growth of less specialized plants.
- Life form diversity is higher than in the Great Basin, but low; perennial species richness is moderately low; but annual wildflower species richness is extremely high and in favorable years they account for a substantial portion of the primary production of the desert.
- In the northeastern portion of the BMCA, near Kingman, Arizona, and along the Colorado River, extensive interdigitation of Sonoran Desert biota is evident.
- The area is slightly to heavily disturbed with some virtually pristine areas. There is a correlation between proximity to urban areas and extent of disturbance. Grazing where water is available, military activities, localized homesteading, and especially recreational activities contribute to the overall disturbance. Disturbance due to recreational use is expanding rapidly.
- Recovery of vegetation after disturbance is slightly slower than in the Great Basin and similar to the Sonoran. Vegetative recovery in the Mojave is restricted largely by the extreme aridity of most of the area.
- Vertebrate fauna is a highly specialized desert fauna similar to, but less diverse than, the Sonoran Desert fauna of LAFR/YTS Arizona BMCA. Nocturnal rodents, lizards and snakes are especially well represented and the avifauna is relatively rich.
- Extensive areas of sand dune formation are found in or near the BMCA. Many of these have specialized sand-dwelling floras and faunas. For instance, the Mojave fringe-toed lizard (*Uma scoparia*), a sand dune species, is restricted to large dune areas in the southern portion of the BMCA. A sand-specialized rodent (*Dipodomys deserti*) is common in suitable habitat.
- The BMCA covers the majority of the Mojave Desert proper.

Aquatic Biology (1.2.3.2.8)

- "Dry playas" hold ephemeral waters and have an invertebrate fauna with one or more desiccation-resistant life cycle stages. Large dry lakes in south of the BMCA include Danby, Cadiz and Bristol Lakes, and in the north, Coyote, Silver and Mesquite Lakes.

- "Wet playas" support a salt-tolerant biota. Soda Lake is the best example in this BMCA of a wet playa, which although dry most of the year, remains damp on its surface.
- Water in playas is generally alkaline, with salinity which varies with water level and precipitation.
- The Mojave and Amargosa Rivers are the major tributaries in the area, and are mostly dry throughout the year.
- The only common native fish occurring in springs are desert pupfish, *Cyprinodon* spp., whereas the brown bullhead, *Ictalurus punctatus*, has been introduced into perennial sections of the Mojave and Amargosa Rivers.
- Habitats for most protected fish are warm, perennial springs, although the lower Colorado River contains the Arizona protected razorback sucker, *Xyrauchen texanus*.

Protected Species (1.2.3.2.9)

- Five protected fishes (Warm Springs pupfish, Devil's Hole pupfish, Pahrump killifish, Tecopa pupfish, and Mojave chub), on the federal endangered species list, occur in or near the BMCA.
- One state (Arizona) protected fish, the razorback sucker, and one frog, the pacific tree frog, may occur in the BMCA.
- The Yuma clapper rail, listed as an endangered species by the federal government, nests along the Colorado River near the BMCA.
- The desert tortoise is sparsely distributed in the BMCA and is considered threatened by Nevada and Arizona.
- Two federally proposed endangered plant species and approximately ten additional plant species under review as threatened species occur within or adjacent to the BMCA in localized populations typically around the mountains.

Economy (1.2.3.2.10) Table 1-8

- Economic area has very large economy; industrial structure similar to that of U.S. economy.
- Total employment grew 18 percent between 1967 and 1975; an increase of 2 percent per year.
- Agricultural employment declined slightly.
- Per capita income is well above the national average and grew less rapidly than U.S. per capita income.
- The most significant gain in earnings was among state and local government workers.

Table 1-8. California Mojave Desert BMCA economic effects province* historic income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	39,614.5	43,611.5	48,268.0
	Per Capita Income[2]	3,671	3,839	4,012
	Relative Per Capita Income[3]	1.15	1.13	1.11
Earnings[1]	Total	32,720.0	35,209.8	37,077.2
	Farm	492.7	495.0	546.7
	Private Nonfarm	27,319.9	29,020.6	30,110.3
	Federal Government	1,562.8	1,755.6	1,796.2
	State and Local Government	3,344.6	3,938.6	4,624.0
Employment[4]	Total	4,481,883	4,843,079	5,297,365
	Farm	73,565	75,011	69,369
	Private Nonfarm	3,709,487	4,009,073	4,359,332
	Government	698,831	758,995	868,664
Labor Force and Unemployment[5]	Civilian Labor Force	NA	4,925,085[6]	5,416,029
	Unemployment	NA	350,820	517,198
	Unemployment Rate (percent)	NA	7.1	9.5

372T-4003

[1]Millions of 1967 dollars.

[6]1972 data.

[2]1967 dollars.

[3]Area per capita divided by national per capita.

[4]Number of jobs.

[5]Annual average.

Sources: U.S. Bureau of Economic Analysis, 1977; California Employment Development Department 1978; Nevada Employment Security Department, 1978; Arizona Department of Employment Security, 1978.

*The economic effects province is composed of Bureau of Economic Analysis economic areas 161, 162, and 165. This includes southern California, southern Nevada, and western and northern Arizona.

- The BMCA counties offer a varied cross section from the urban industrial development of western San Bernardino County and Las Vegas to the vast undeveloped reaches of San Bernardino County, California and Mojave County, Arizona.
- The value of agricultural products sold in 1974 averaged $1,700 per mi^2.

<u>Social Environment</u> (1.2.3.2.11)

- Population of BMCA counties (San Bernardino, Mojave and Clark) stood at 1.07 million in 1975, or 4.5 percent of the population of the states of California, Arizona and Nevada; expected to grow to 1.4 million by 1990, representing 5.1 percent of the states of California, Arizona and Nevada. The overall density of these counties was 30.4 persons per mi^2, and the rural density was 1.9 persons per mi^2.
- The median level of education completed by adults in the BMCA counties is about 12.2 years.
- Dwelling unit occupancy rates among BMCA counties in 1970 was lower than state average in California and Arizona, but higher in Nevada.

<u>Community Infrastructure</u> (1.2.3.2.12)

- The two largest suppliers of electrical energy in the BMCA counties are Southern California Edison and Nevada Power Company. The Western Systems Coordinating Council projects a 7,000 to 19,500 MW surplus generating capacity in this region in 1986 (DOE, 1978).
- Water is imported into San Bernardino County from Owens Valley and from northern California. The Colorado River serves the other two BMCA counties.
- The BMCA counties are traversed by I-15, I-40, U.S. 95, and U.S. 93.

<u>Cultural Resources</u> (1.2.3.2.13)

- Archaeological sites in BMCA include campsites, trails, rock shelters, and caves in mountainous areas.
- Archaeological sites expected in close proximity to past or present water sources.

- Rock art in form of petroglyphs, pictographs, and intaglios occurs in BMCA. Rock features such as sleeping circles also are in BMCA.
- Historic mines, forts, and transportation routes are in BMCA.

Luke Air Force Range/Yuma Test Site and Adjacent Areas BMCA (1.2.3.3)

The Luke AF/Yuma TS BMCA was picked as a sample of the geotechnically suitable areas in the Sonoran Desert. Figure 1-13 shows this sample area as well as other geotechnically suitable areas nearby. The outlined areas on the figure, representing the BMCA, contain approximately 6,900 square miles (11,100 km^2). This is the estimated area required for nominal spacing area security deployment of 155 missiles in buried trenches, 170 in horizontal shelters, 225 in vertical shelters and 170 in pools. In expanded spacing, 95 missiles in trenches, 55 in horizontal shelters, 55 in vertical shelters, and 60 in pools could be accumulated. Differences between modes depend on the nominal spacings (Table 1-1) and the unsuitability of about 10 percent of the area for vertical shelters due to greater depth of the vertical shelters below the surface. Transportation and utility corridors are not shown but have been accounted for in numbers deployed. The outlined areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

Geologic Environment (1.2.3.3.1)

- Mature basin and range, arid land topography with extensive alluvial fan formations burying the narrow steep mountain ranges which are their source.
- Alluvial valleys broaden in the southern portion of the BMCA and are separated by narrow northwest-southeast trending ranges; elsewhere in the BMCA, mountains have random orientation but alluvial valleys still extensive.
- Other prominent features typical of very arid land topography are extensive areas of desert pavement and common occurrence of pediments near mountains.
- Water erosion of the mountains is the prominent landform-modifying process in the BMCA and flash flooding leaving dissected pediments and alluvial fans is common in this area as is sheet flooding.
- Wind erosion has deflated playas and alluvial slopes; it is partially responsible for the occurrence of desert pavement, and accumulation of windblown sand in dunes and sheets is common. The best-developed dune system is the Mohawk Dunes west of and parallel to the Mohawk Mountains.

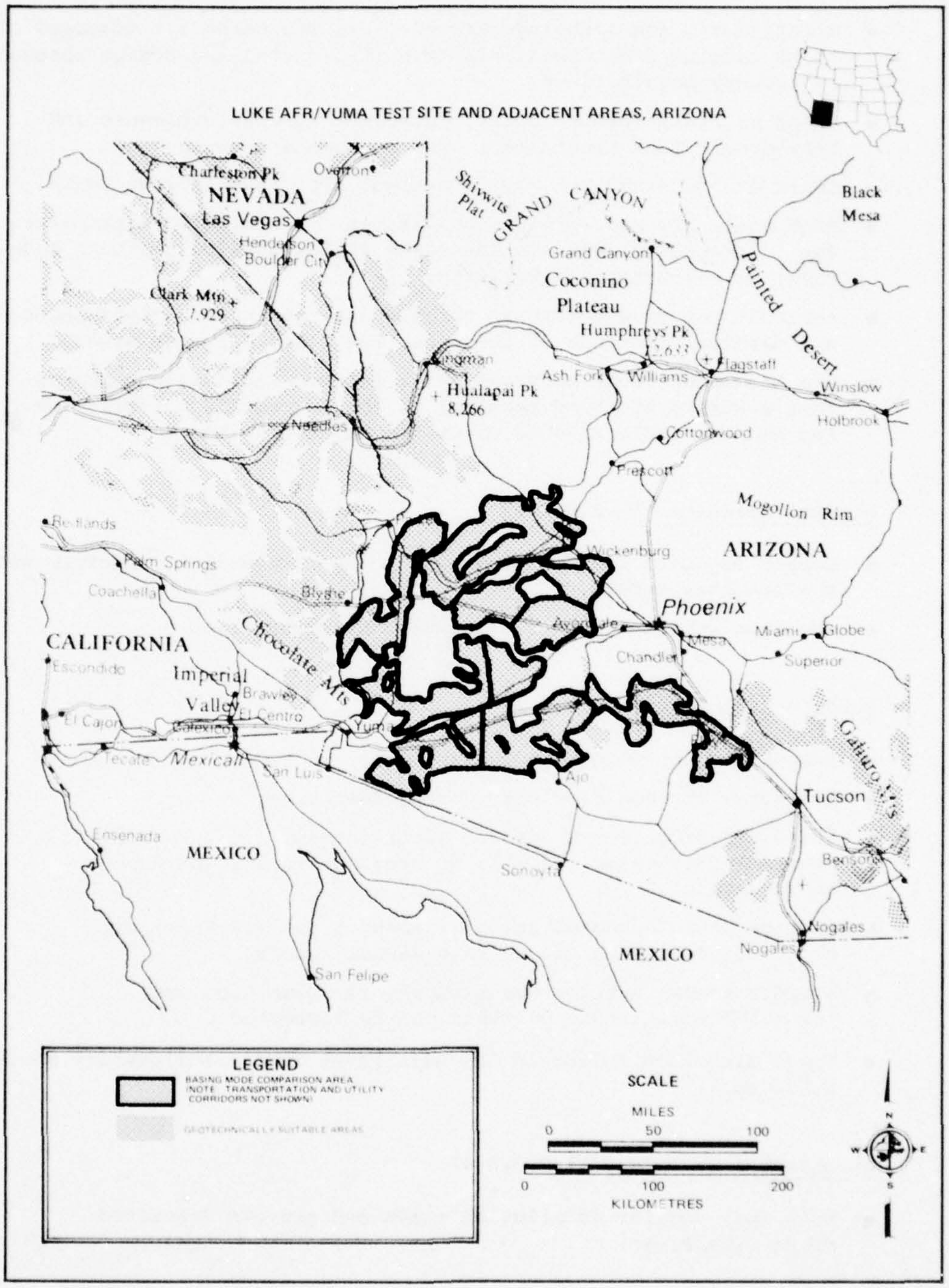

Figure 1-13. Luke/Yuma basing mode comparison area.

- Stratigraphy and lithology are complex; mountains are composed of rocks ranging from Precambrian granite, gneiss and schist through Quaternary basalt flows.
- Among mountain-forming rocks, intrusive igneous, volcanic and metamorphic rock predominate over sedimentary rocks.
- Soils are generally poorly-developed, typical arid-zone soils.
- Most soils are more or less unsuitable for irrigated agriculture due to excessive drainage characteristics; shallow depth to bed-rock; or salinity or alkalinity.
- Agricultural development is chiefly confined to the floodplains and alluvial terraces of the Gila, Salt, and Colorado Rivers.
- The Algodonec fault with potential seismic implications passes just westerly of third parallel to the Lechugilla Desert. The San Andreas fault lies 60 miles (96 km) to the west.

Mineral Resources (1.2.3.3.2)

- Copper deposits found in basement rock of mountains, together with the precious metals.
- Abundant sand and gravel available for aggregate.

Surface Hydrology (1.2.3.3.3)

- Essentially no permanent surface water in BMCA.
- Ephemeral streams flow only during downpours.
- Flash flooding is commonplace after intense local rainfall events and these are capable of causing significant damage to structures.
- Average annual precipitation is about 5 in. (12.5 cm) with about 0.1 in. (0.25 cm) average annual runoff.
- Average annual surface water supply is about 0.05 maf (61×10^6 m^3), little of which can be harvested.
- Total dissolved solids in the Gila River (when it flows)are about 4,000 mg/l.

Groundwater Hydrology (1.2.3.3.4)

- Principal aquifer is alluvial sands and gravels deposited along Gila River.

- Minor aquifers are valley-fill deposits.
- Water quality is variable and measured values range from 350 to more than 2,000 mg/l TDS for older alluvial deposits to 1,400 to 4,000 mg/l TDS for younger deposits.
- Estimated groundwater storage is 50 million acre-feet (62×10^9 m^3).
- No indication of subsidence due to groundwater withdrawal.

Meteorology (1.2.3.3.5)

- Long hot summers and mild winters.
- Mean annual precipitation ranges from about 3 in. (7.5 cm) to over 10 in. (25 cm) depending on elevation.
- Widespread thunderstorm activity occurs in July and August with occasional heavy precipitation causing local flash floods.
- Surface winds are light and show little seasonal dependence.
- Dust storms occur several times each summer throughout the region usually associated with thunderstorms and lasting up to 3 hours.
- Shallow mixing depths and light winds produce poor dispersion conditions throughout the area in all seasons.

Air Quality (1.2.3.3.6)

- Twenty-four hour particulate levels frequently exceed strict Arizona standards. Sulfur dioxide levels rarely exceed standards while carbon monoxide and nitrogen dioxide levels remained well below standards.
- One Mandatory Class I Area (no degradation permitted), Superstition Mountain National Wilderness Area lies within 50 mi (81 km) of the BMCA boundary.

Terrestrial Biology (1.2.3.3.7)

- Vegetation of much of the BMCA is a diverse Sonoran Desert scrub typical of a limited area of southwestern Arizona.
- Lifeform diversity of this type is unparalleled in the United States and perennial plant species richness is extremely high.
- The extreme southwestern portion of the BMCA contains extensive areas of sparsely vegetated desert pavement with the diverse,

arborescent species restricted to natural drainageways. The northwestern portion of the BMCA contains areas of floral interchange with the Mojave Desert.

- Much of the habitat is nearly pristine due mainly to lack of water which has precluded livestock grazing to a large extent.
- Revegetation is slower than any other BMCA because of the longevity of many of the arborescent species coupled with considerable aridity which restricts conditions for establishment of some of the species (e.g., Saguaro cactus).
- Vertebrate fauna is richest of the BMCAs in nocturnal rodents, lizards, and snakes; birds other than waterfowl are also relatively well-represented. Game animals such as the peccary and the burro deer are found in the BMCA.
- Much of the area is undisturbed; some intensive cultivation occurs in suitable areas, particularly along the Gila and Colorado Rivers and in Aguila Valley. Impact of grazing is confined to areas where water has been developed.

Aquatic Biology (1.2.3.3.8)

- The Colorado River and its reservoirs on the western side of the BMCA and the Bill Williams River to the north are the major permanent water bodies in the BMCA.
- The main channel and the quiet backwaters of the reservoirs of the Colorado River provide habitat for three protected species, the razorback sucker (*Xyrauchen texanus*), bonytail chub (*Gila elegans*) and roundtail chub (*Gila robusta grahami*).
- Ephemeral ponds and stock tanks are important breeding habitat for the several amphibian species in the BMCA; they also support an aquatic invertebrate biota adapted to very brief periods of water availability.
- Aside from the developed stock tanks in the area, the only semi-permanent water sources for wildlife are "rock" or "sand" tanks common in the Tinajas Altas, Aguila and Crater Mountains and Vekol Valley. These are canyons that fill with water during storms and slowly evaporate. They contain algae and small crustaceans and abundant populations of an ostracod (*Cyprinotus*).

Protected Species (1.2.3.3.9)

- The federally endangered Sonoran pronghorn antelope occurs in the BMCA which includes a portion of the proposed critical habitat for this species.

- The Yuma clapper rail, a federally endangered bird species, nests along the Colorado River near the BMCA.
- Two reptiles (the desert tortoise and Gila monster) are considered threatened by Arizona and are present in the BMCA.
- One federally proposed endangered plant species and possibly three species under review as threatened species are known to occur within or near the BMCA.
- At least three fish species (the threatened razorback sucker, bonytail and roundtail chubs) found in the Colorado River are protected by state regulations.

Economy (1.2.3.3.10) Table 1-9

- Phoenix SMSA, among the fastest growing in the nation, is the economic hub of the province.
- Growth during 1967-75 period continued to be dominated by an influx of retired persons; some expansion in manufacturing has been experienced.
- Total employment increased 39 percent between 1967 and 1975 maintaining steady growth throughout the period.
- Farm employment has fallen steeply; trade, construction, and state and local government employment have grown rapidly.
- Per capita income rose slightly relative to the U.S. average, standing at 91 percent of national level in 1975; reflecting high proportion of retired persons.
- Earnings grew at exceptionally rapid rate between 1967-70, an average annual rate of 8 percent per year; moderate growth experienced in 1970-75 period.
- Public expenditures for education and highways relatively high; for public welfare relatively low.
- The value of agricultural products sold in 1974 averaged \$26,900 per mi^2.

Social Environment (1.2.3.3.11)

- Continued population growth is expected for the BMCA counties, which was 1.3 million in 1975. About 55 percent of 1970 population is found in the city of Phoenix. The overall density of the BMCA counties was 39.1 persons per mi^2, and the rural density was 3.0 persons per mi^2.

Table 1-9. Luke/Yuma BMCA economic effects province* historical income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	4,515.9	5,647.6	7,333.3
	Per Capita Income[2]	2,843	3,152	3,297
	Relative Per Capita Income[3]	0.89	0.92	0.91
Earnings[1]	Total	3,626.3	4,501.0	5,407.6
	Farm	215.9	215.9	190.6
	Private Nonfarm	2,595.1	3,315.1	3,936.1
	Federal Government	381.3	432.1	503.5
	State and Local Government	434.0	537.9	777.4
Employment[4]	Total	601,980	711,869	839,492
	Farm	36,553	36,249	20,954
	Private Nonfarm	433,361	528,384	624,073
	Government	132,066	147,236	194,465
Labor Force and Unemployment[5]	Civilian Labor Force	560,098	622,175	890,725
	Unemployment	25,300	28,275	88,850
	Unemployment Rate (percent)	4.5	4.3	10.0

372T-4004

[1]Millions of 1967 dollars.

[2]1967 dollars.

[3]Area per capita divided by national per capita.

[4]Number of jobs.

[5]Annual average.

Sources: U.S. Bureau of Economic Analysis, 1977; Arizona Department of Employment Security, 1978.

*The economic effects province is comprised of Bureau of Economic Analysis economic areas 162 and 163, comprising all of Arizona.

- Occupancy of dwelling units in the BMCA counties stood at 9[illegible] percent in 1970, slightly above the state and national rat[illegible].
- [illegible]ian education completed by adults is about 12.3 years.

Community Infrastructure (1.2.3.3.12)

- Despite arid conditions, present water rates are relatively low; two-thirds of water from groundwater reserves; completion of Central Arizona Project will reduce overdraft on central state groundwater reserves.
- Electrical generating capacity in Arizona grew 75 percent per year between 19[illegible] and 1975; production expanded at an 8.7 percent rate; 27 percent of 1975 capacity is hydroelectric. The Western Systems Coordinating Council projects a 7,000 to 19,500 MW surplus generating capacity in the region in 1986 (DOE, 1978).
- Major new electrical generative capacity will be supplied by coal fired and nuclear plants through 1985. Substantial low-sulfur coal reserves exist in n[illegible]eastern Arizona.
- Numerous highways including [illegible] and I-8 and two rail lines traverse the area.

Cultural Resources (1.2.3.3.[illegible])

- Permanent habitation sites, campsites, trails, rock features, and lithic sites may occur in the BMCA.
- Many archaeological sites that occur away from rivers in southwest Arizona have little or no depth below present day land surface.
- Prospectors' camps, mining claim-markers, and mining-related sites may be encountered.

White Sands Missile Range and Adjacent Areas, New Mexico BMCA (1.2.3.4)

The White Sands MR BMCA was selected as a sample of the geotechnically suitable areas in the New Mexican Grassland. Figure 1-14 shows this [illegible] area as well as other geotechnically suitable areas nearby. The outlined areas, representing the BMCA, contain approximately 6,900 square miles (11,100 km^2). This is the estimated area required for normal spacing area security deployment of 155 missiles in buried trenches, 175 in horizontal shelters, 155 in vertical shelters and [illegible] pools. In expanded spacing 95 missiles in trenches, 55 in horizontal shelters, 55 in vertical shelters and 60 in pools can be accommodated.

- Occupancy of dwelling units in the BMCA counties stood at 94 percent in 1970, slightly above the state and national rate.
- Median education completed by adults is about 12.3 years.

Community Infrastructure (1.2.3.3.12)

- Despite arid conditions, present water rates are relatively low; two-thirds of water from groundwater reserves; completion of Central Arizona Project will reduce overdraft in central state groundwater reserves.
- Electrical generating capacity in Arizona grew 75 percent per year between 1965 and 1975; production expanded at an 8.7 percent rate; 27 percent of 1975 capacity was hydroelectric. The Western Systems Coordinating Council projects a 7,000 to 19,500 MW surplus generating capacity in this region in 1986 (DOE, 1978).
- Major new electrical generative capacity will be supplied by coal fired and nuclear plants through 1985. Substantial low-sulfur coal reserves exist in northeastern Arizona.
- Numerous highways including I-10 and I-8 and two rail lines traverse the area.

Cultural Resources (1.2.3.3.13)

- Permanent habitation sites, campsites, trails, rock features, and lithic sites may occur in the BMCA.
- Many archaeological sites that occur away from rivers in southwest Arizona have little or no depth below present day land surface.
- Prospectors' camps, mining claim-markers, and mining-related sites may be encountered.

White Sands Missile Range and Adjacent Areas, New Mexico BMCA (1.2.3.4)

The White Sands MR BMCA was selected as a sample of the geotechnically suitable areas in the New Mexican Grassland. Figure 1-14 shows this sample area as well as other geotechnically suitable areas nearby. The outlined areas, representing the BMCA, contain approximately 6,900 square miles (11,100 km^2). This is the estimated area required for nominal spacing area security deployment of 155 missiles in buried trenches, 175 in horizontal shelters, 155 in vertical shelters and 175 in pools. In expanded spacing 95 missiles in trenches, 55 in horizontal shelters, 55 in vertical shelters and 60 in pools can be accommodated.

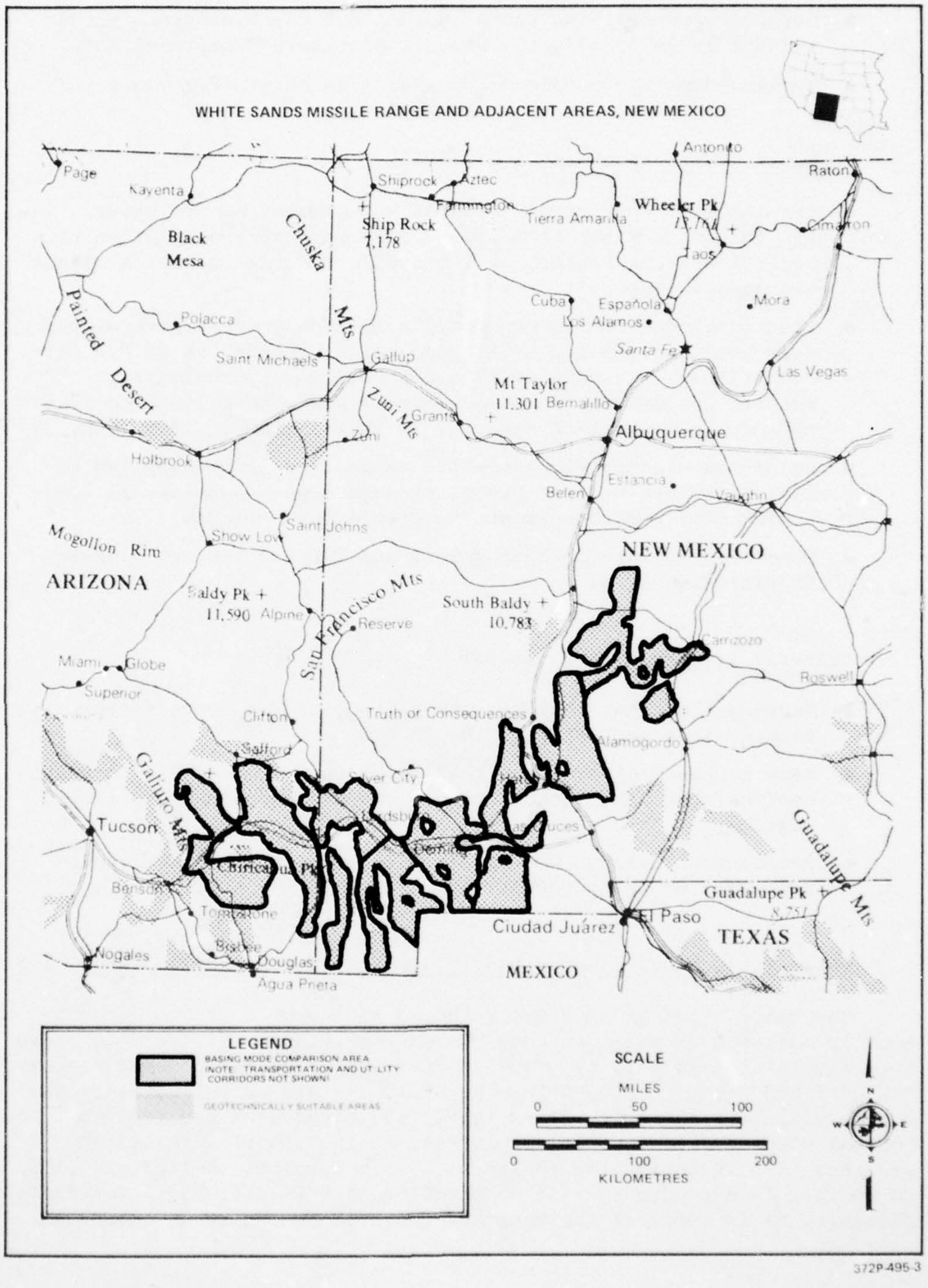

Figure 1-14. White Sands basing mode comparison area.

Differences between modes depend on the nominal spacings (Table 1-1) and the unsuitability of about 40 percent of the area for vertical shelters due to greater depth of the vertical shelters below the surface. Transportation and utility corridors are not shown but have been accounted for in numbers deployed. The outlined areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

Geologic Environment (1.2.3.4.1)

- Basin and range topography, some are closed such as Jornada del Muerto Valley; other basins are open and flow into the Rio Grande.
- Valleys are filled by alluvial and playa sediments with dunes or sheets of windblown sand deposited locally especially on the Jornada del Muerto. This includes the unique gypsum sand dunes from which the range derives its name.
- Active Tertiary and Quaternary uplift has resulted in a young block-faulted mountain topography and entrenchment of the Rio Grande with resultant dissection of the basin deposits near the river.
- Rock units in the mountains range from Precambrian igneous and metamorphic rock, through conspicuous Paleozoic sedimentary strata and Tertiary volcanic and intrusive rocks. The Quaternary is represented by a 200 mi^2 (518 km^2) basalt flow in the Jornada del Muerto, alluvial, floodplain, and playa deposits, and dune and sheet sand.
- Soils are variable in virtually every respect except that all are relatively dry and most have a moderately to well-developed caliche horizon. Soils in the Rio Grande Valley are cleared and used for irrigated cropland, most of the remaining soils are used as rangeland and support desert grassland, degraded desert grassland and desert scrub. There is some potential for expansion of irrigated agriculture in the region.

Mineral Resources (1.2.3.4.2)

- Little large-scale mining activity within the BMCA, but deposits of a wide variety of metals are located in the mountains of the BMCA.
- Rio Grande Valley contains two Known Geothermal Resource Areas and is potentially valuable for geothermal resources throughout its length in the BMCA.
- Adequate sources of sand and gravel for aggregate are located within the BMCA.

Surface Hydrology (1.2.3.4.3)

- Precipitation averages less than 10 in. (25 cm) annually and runoff averages 0.1 in. (0.25 cm) annually.
- Rio Grande is main river in the area.
- Surface water supply of 0.2 million acre-ft (0.25 x 10^9 m^3) annually is equal to present agricultural usage.

Groundwater Hydrology (1.2.3.4.4)

- Principal aquifer is Rio Grande Valley fill with about 100 ft (30.5 m) depth to groundwater away from the river; wells typically yield 250 to 2,000 gpm (1 to 7.5 m^3/min) of water variable in quality (TDS range from 100 mg/l to more than 2,000 mg/l). Along the river depth to groundwater is less than 10 ft (3 m).
- Water in the closed basins is poorer in quality; may be at greater depth (e.g., 300 to 350 ft (91.5 to 107 m) in the Jornada del Muerto).
- Groundwater table lowering is reported in the vicinity of major municipal water supplies; no indication of ground subsidence resulting from groundwater withdrawal.
- Estimated groundwater storage is 100 million acre-ft (123 x 10^9 m^3) in the area.

Meteorology (1.2.3.4.5)

- A high desert region with abundant sunshine, low humidity, and mild winters; average annual temperature is 41-81° F (5-27° C).
- Precipitation falls mainly in July, August, and September with the annual mean ranging from 8 to 14 in. (20-25 cm).
- Surface winds are light and show little seasonal change.
- Occasional cyclonic storms in fall and spring cause widespread dust. Dust may also be raised for short periods by winds associated with rapidly moving cold fronts.
- Radiation inversions are common at night year-round and cause restricted vertical mixing of pollutants until well after sunrise on many days.
- Flash flooding possible in localized areas.

Air Quality (1.2.3.4.6)

- Twenty-four hour particulate levels and one-hour carbon monoxide levels rarely exceed strict New Mexico standards. Sulfur dioxide and nitrogen dioxide levels remain well below standards. Ozone levels are generally high in urban areas and low in rural areas.
- Two Mandatory Class I (no degradation permitted) areas lie within 50 mi (81 km) of the BMCA boundary; Gila National Wilderness Area and Chiricahua Wilderness Area.

Terrestrial Biology (1.2.3.4.7)

- Vegetation in BMCA is desert grassland, or degraded desert grassland. In some areas (e.g., Rio Grande Valley) vegetation has changed to desert scrub the result of a long history of overgrazing. Chihuahuan Desert scrub exists in the southern portion of the BMCA.
- Disturbance of the area is variable; most is rangeland with some (e.g., portions of the Jornada del Muerto within WSMR and San Agustin Plains) in good to excellent condition; other areas in poor condition. Cropland covers much of lower Rio Grande Valley.
- Plant succession is moderately slow in BMCA, due primarily to aridity and slow growth of some long-lived perennial species.
- Lifeform diversity and plant species richness are low to moderate; mosaic of contrasting soil types increases vegetational diversity within BMCA. This is especially noticeable in the Tularosa Basin which contains both a white, gypsum sand area (White Sands National Monument) and a major lava flow (Carrizozo Malpais).
- Vertebrate fauna is a relatively rich desert fauna. Wildlife populations are especially high on WSMR because of human exclusion and cessation of grazing in past 30 years.
- An especially rich fauna which contains several Mexican species (many of them protected) is found in the Animas Valley area in the southwestern portion of the BMCA.
- Nocturnal rodent and reptilian faunas are diverse; major game mammals are pronghorn antelope and mule deer.
- Introduced exotic game species in the BMCA include barbary sheep and oryx.
- The amphibian fauna is unusually diverse for a desert region because of the Rio Grande River and numerous ephemeral playas and man-made cattle water tanks that contain summer breeding

aggregations of true toads and spadefoot toads. Many of the cattle tanks also contain populations of the tiger salamander, whose larval stage is used for fish bait.

Aquatic Biology (1.2.3.4.8)

- The Rio Grande and its lakes (Elephant Butte and Caballo) and tributaries form the major aquatic habitat in this BMCA. Warm water, high sediment content and high levels of calcium and magnesium salts limit the aquatic fauna. Gizzard shad (*Dorosoma cepedianum*) are common, feeding on abundant plankton. Benthic organisms are scarce, as well as aquatic macrophytes in the reservoirs as a result of fluctuating water levels.
- The Gila and Mimbres Rivers form the two other major aquatic habitats in the area, although both of the rivers dry up before emptying into receiving waters. Water quality in the upper reaches of these rivers is better (lower TDS) than the Rio Grande, although flow is more variable. Many endemic protected fish species occur in the headwaters and middle reaches of these two rivers.
- Playas and temporary ponds are important breeding areas for amphibians. Rooted aquatic macrophytes and insects abound in these areas, although fish are scarce.
- In the Tularosa Valley, perennial springs provide water for Salt Creek and habitat for several endemic (protected) fish species.

Protected Species (1.2.3.4.9)

- The federally endangered whooping crane, Mexican duck, and American peregrine falcon are seasonally present in or near the BMCA, and the federally endangered Soccoro isoped is found near the Rio Grande River.
- Although no federally protected aquatic or semi-aquatic biota occur in or near the BMCA in New Mexico and Arizona, eleven state protected fishes and two toads are found in or near the Rio Grande.
- The state protected endangered Gila monster and buff-breasted fly catcher are present in portions of the BMCA.
- Southernmost portions of the BMCA, in a restricted area of Hidalgo County, contain over 30 species and subspecies considered threatened or endangered by New Mexico.

- Approximately four federally proposed endangered plant species and five species under review as threatened species are known to occur in a variety of habitat types within or adjacent to the BMCA.

Economy (1.2.3.4.10) Table 1-10

- Economic effects province is dominated by three metropolitan areas: Tucson, El Paso, and Albuquerque.
- Growth trends show increases in private nonfarm and government employment and earnings.
- Agricultural employment has declined in recent years, but extensive agriculture—mostly feed grains and livestock—is still an important force in the economy.
- Per capita income, which has traditionally been low in the region, falling relative to the nation between 1967 and 1975, standing at 73 percent of the national average in 1975.
- Area public expenditures on education and highways relatively high, and on public welfare relatively low, compared to other western states.
- The value of agricultural products sold in 1974 averaged \$26,900 per mi^2.

Social Environment (1.2.3.4.11)

- Twenty cities account for about 60 percent of 1970 BMCA county population, reflecting the rural, undeveloped character of much of the area, which has an average density of 2.0 persons per square mile excluding city population. The overall density of the BMCA counties was 5.3 persons per mi^2, and the rural density was 2.0 persons per mi^2.
- Educational attainment in the BMCA counties is comparable to New Mexico state figures which was 12.2 years.
- BMCA counties have shown recent growth in housing units with about 50 percent of the housing units at least 20 years old in 1970.

Community Infrastructure (1.2.3.4.12)

- Water supplies in the BMCA counties could limit growth; groundwater is found mostly along the Rio Grande and is of poor quality.

Table 1-10. White Sands Missile Range BMCA economic effects province* historical income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	4,197.6	4,766.2	6,018.9
	Per Capita Income[2]	2,451	2,769	3,024
	Relative Per Capita Income[3]	0.77	0.81	0.83
Earnings[1]	Total	3,450.9	3,764.6	4,490.1
	Farm	188.1	123.7	138.5
	Private Nonfarm	2,134.3	2,434.3	2,960.2
	Federal Government	667.2	674.8	704.9
	State and Local Government	461.3	531.8	686.5
Employment[4]	Total	453,531	503,665	601,108
	Farm	23,191	19,929	17,646
	Private Nonfarm	306,070	341,655	417,097
	Government	134,270	142,081	166,365
Labor Force and Unemployment[5]	Civilian Labor Force	NA	NA	784,539
	Unemployment	NA	NA	72,026
	Unemployment Rate (percent)	4.9	6.4	9.2

372T-4005

[1]Millions of 1967 dollars.

[2]1967 dollars.

[3]Area per capita divided by national per capita.

[4]Number of jobs.

[5]Annual average.

Sources: U.S. Bureau of Economic Analysis, 1977; New Mexico Employment Security Commission, 1978; Texas Employment Commission, 1978.

*The economic effects province is composed of Bureau of Economic Analysis economic areas 145, 146, and 163. This includes most of New Mexico and southeastern Arizona.

- Electrical generation in New Mexico is almost exclusively from fossil fuel with 70 percent from petroleum. Crude oil production was down about 30 percent between 1970 and 1975. But natural gas production expanded moderately. Coal production is expected to expand rapidly in the next ten years. The Western Systems Coordinating Council projects a 7,000 to 19,500 MW surplus generating capacity in this region in 1986 (DOE, 1978).
- Interstate Highways 10 and 25 traverse the BMCA counties, with the most heavily travelled route being through Las Cruces to El Paso, Texas.

<u>Cultural Resources</u> (1.2.3.4.13)

- Archaeological coverage is uneven but site potential is high in all environmental zones.
- Prehistoric remains are expected to include village sites, campsites, rockshelters and caves, sherd and lithic scatters, and isolated artifacts.
- Some historic sites might date to the Spanish period, but most should date to the Mexican and American periods. Homesteads, ranches, and mining-related sites are expected.

<u>West Texas Including Rio Grande Basin BMCA</u> (1.2.3.5)

The West Texas/Rio Grande BMCA was selected as a sample of the geotechnically suitable areas in the Trans-Pecos Chihuahuan Steppe. Figure 1-15 shows this sample area as well as other geotechnically suitable areas nearby. The outlined areas, representing the BMCA, contain approximately 6,900 sq mi (11,100 km^2). This is the estimated area required for nominal spacing area security deployment of 150 missiles in buried trenches, 170 in horizontal shelters, 160 in vertical shelters and 165 in pools. In expanded spacing, 90 missiles in trenches, 55 in horizontal shelters, 55 in vertical shelters and 55 in pools can be accommodated. Differences between modes depend on the nominal spacings (Table 1-1) and the unsuitability of about 35 percent of the area for vertical shelters due to greater depth of the vertical shelters below the surface. Transportation and utility corridors are not shown, but have been accounted for in numbers deployed. The outlined areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

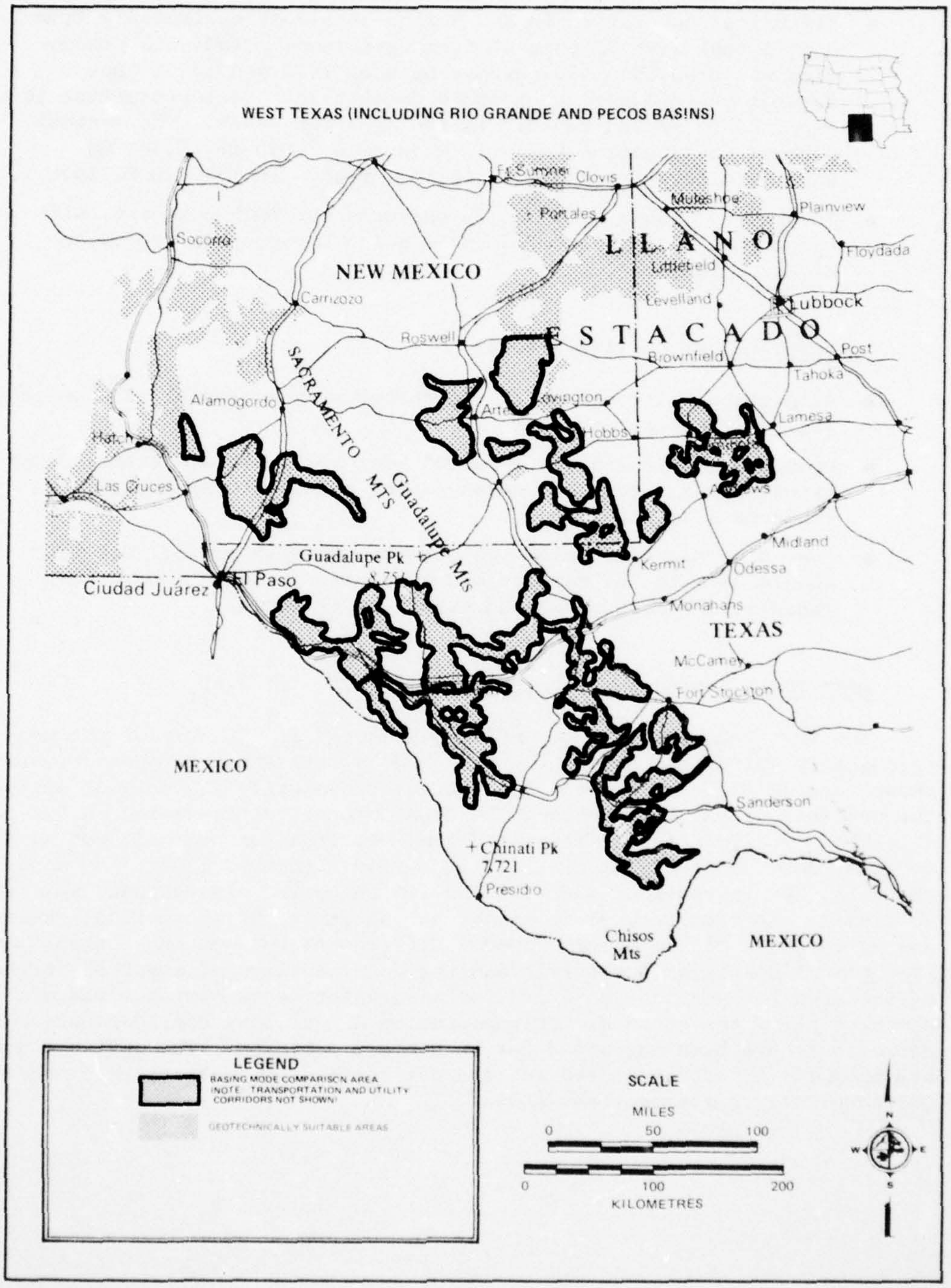

Figure 1-15. West Texas basing mode comparison area.

Geologic Environment (1.2.3.5.1)

- Area is complexly transitional between basin/range topography and Texas high plains geomorphic configuration.
- The most suitable terrain comprises basins of internal drainages and, also, those that drain into the Rio Grande.
- High relief and, in many instances, appreciable slope gradients have produced continuing deep incision of the land by water. Eolian erosion is also manifested by an abundance of wind-scoured cliffs.
- Mountain ranges are of the fold and fault type in the main, with some volcanic expressions. The exposed rocks are varied, comprising pre-Cambrian para- and orthometamorphics, Mesogoic carbonates and other sedimentaries, and Tertiary intrusives and volcanic flow material.
- Basin sediments mostly Quaternary fanglomerates near mountains grading rapidly to fine-textured soils toward valley floors, alkali and gypsiferous deposits common in and near valley bottoms.
- Soils tend to be fine-textured, generally alkaline, poor in available plant nutrients, susceptible to wind and water erosion. Soils can support range and some irrigated crops.
- A tectonic belt with potential seismic activity, the Texas Lineament, passes through the BMCA.

Mineral Resources (1.2.3.5.2)

- Metarhyolite quarries in nearby mountains produce railroad ballast.
- Construction sand and gravel are available in quantity in fanglomerates produced by Quaternary uplift.
- Oil and gas produced from scattered wells and fields in the area.
- Salt, gypsum, and potash are obtained from alkali playas.

Surface Hydrology (1.2.3.5.3)

- Precipitation averages less than 10 in. (25.4 cm) annually with a runoff of about 0.1 in. (.25 cm) on the average.
- Ephemeral streams are numerous in the area.
- Present irrigation use equals the present Rio Grande supply of 2.4 maf (3×10^9 m^3), therefore, no surface water is available for construction.

Groundwater Hydrology (1.2.3.5.4)

- The major sources of groundwater in the area are valley fill and lacustrine deposits.
- Depth to water averages 50 to 200 ft (15 to 61 m).
- The primary supply comes from the salt basin and is approximately 20 maf (25×10^9 m^3) plus large volumes of more saline water. Yield is from 50 to several hundred gpm (.2 to 3^3m /min) from valley-fill wells.
- A lowering of up to 75 ft (23 m) of the groundwater table has occurred during historic use.
- No subsidence from the groundwater withdrawal has been noted.

Meteorology (1.2.3.5.5)

- Typical hot desert climate (i.e., large diurnal temperature fluctuations, abundance of sunshine, low humidity, scanty and variable rainfall, relatively mild winters) moderated by relatively high elevations.
- Rainfall bimodal, 40 to 60 percent from July-August-September thunderstorms from Gulf of Mexico, small December-January peak from Pacific cyclonic storms.
- High potential for summer flash flooding.
- Synoptic systems of secondary importance overall, but winter cyclonic storms with sharp cold fronts important in causing severe dust storm disperson.
- Nocturnal temperature inversions restrict vertical mixing of pollutants.

Air Quality (1.2.3.5.6)

- Twenty-four hour particulate levels frequently exceed state and national standards. Sulfur dioxide, ozone, nitrogen dioxide, and carbon monoxide levels are below standards.
- Two Mandatory Class I (no degradation permitted) areas lie within 50 mi (81 km) of the BMCA boundary; Carlsbad Caverns National Park and Guadalupe Mountains National Wilderness Area.

Terrestrial Biology (1.2.3.5.7)

- West Texas is a transition zone for Great Plains, Chihuahuan Desert, Rocky Mountain and Mexican biotas. There is a considerable heterogeneity in species composition from place to place in the BMCA.
- Vegetation in the southern portion of BMCA and along Rio Grande River is Chihuahuan Desert scrub. Desert grassland is found on topographically suitable sites in most of the BMCA.
- Low to moderate disturbance of the area in the form of gradual invasion of grassland by shrubs, and changes in floristic composition due to cattle grazing.
- Rich flora; grasses and forbs especially well represented in species; many species of restricted occurrence in U.S.; plant species richness equaled only by LAFR/Yuma test site and vicinity, Arizona BMCA.
- Northern portion of BMCA in vicinity of Kermit, Texas, contains large areas of mesquite scrub, but areas just to the north around Hobbs, New Mexico, are arid grassland.
- Rich fauna with typical desert grassland and Chihuahuan Desert species intermixed with Mexican and Rocky Mountain forms. The fauna has transition zones running both north-south and east-west.
- Reptilian diversity is especially high with unusual numbers of species of lizards and snakes. Faunal diversity as high as in Sonoran Desert BMCA.
- White-tailed deer, mule deer, pronghorn antelope are important game species.

Aquatic Biology (1.2.3.5.8)

- The Rio Grande River, the Pecos River, Balmorhea Lake and Springs, Toyah Creek and Playa, and Imperial and Red Bluff Reservoirs on Pecos River are major aquatic features in the BMCA.
- The few ephemeral streams and Toyah Playa contain typical drought-resistant invertebrates. Benthic production is low and these habitats are devoid of fish.
- The fish populations of the Pecos River, its tributary Toyah Creek and the reservoirs include the plains minnow (*Fundulus kansae*), the plains killifish (*Hybognathus placitus*), the red shiner (*Notropis lutrensis*) and the gizzard shad (*Dorosoma cepedianum*).

- Most protected fish and amphibians reside in or near the Pecos River and its tributaries from Roswell, New Mexico, south, in the Rio Grande and its tributaries entering the BMCA, and in spring-filled ditches near Toyahville, and Fort Stockton, Texas.

Protected Species (1.2.3.5.8)

- The federally endangered Comanche Springs pupfish and Pecos gambusia occur near Toyahville in the BMCA.
- The White Sands pupfish and black-tailed prairie dog may be present in the BMCA and are protected as threatened species by New Mexico.
- Several reptiles (Texas horned lizard, mountain short-horned lizard, Trans-Pecos rat snake, Big Bend milk snake, gray-banded kingsnake, and lyre snake) are protected by Texas as threatened species and occur in the BMCA.
- Thirteen state-protected fish and two frogs are associated with the Pecos and Rio Grande Rivers and may be present within 10 mi (16 km) of the BMCA.
- Approximately 11 federally proposed endangered plant species and an additional five species under review as threatened species are known to occur within or adjacent to the BMCA; most occur on low hills of unusual rock types.

Economy (1.2.3.5.10) Table 1-11

- The economic effects province is dominated by two metropolitan areas—El Paso and Midland; the former has experienced important gains in manufacturing in recent years.
- Agriculture, important in the economic area, has declined in recent years. It is predominantly livestock and feed grain. The value of agricultural products sold in 1974 averaged \$8,100 per mi^2.
- Both employment and earnings grew moderately between 1967 and 1975 (25 percent and 19 percent increases, respectively).
- Per capita income grew from 82 percent of the U.S. average in 1970 to 132 percent in 1975.
- Recent losses in federal government earnings and employment have been more than offset by gains in private nonfarm and state and local government.

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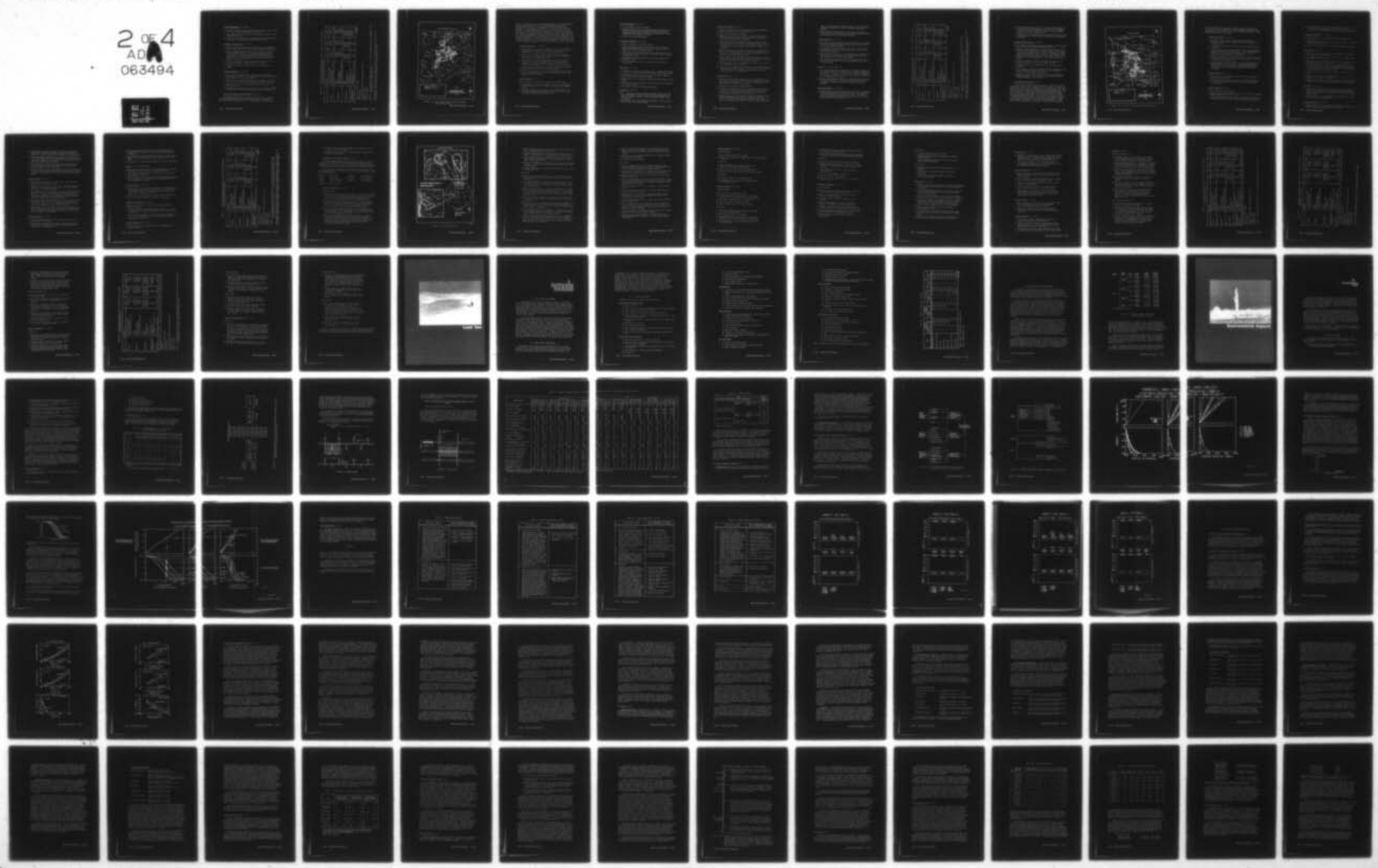

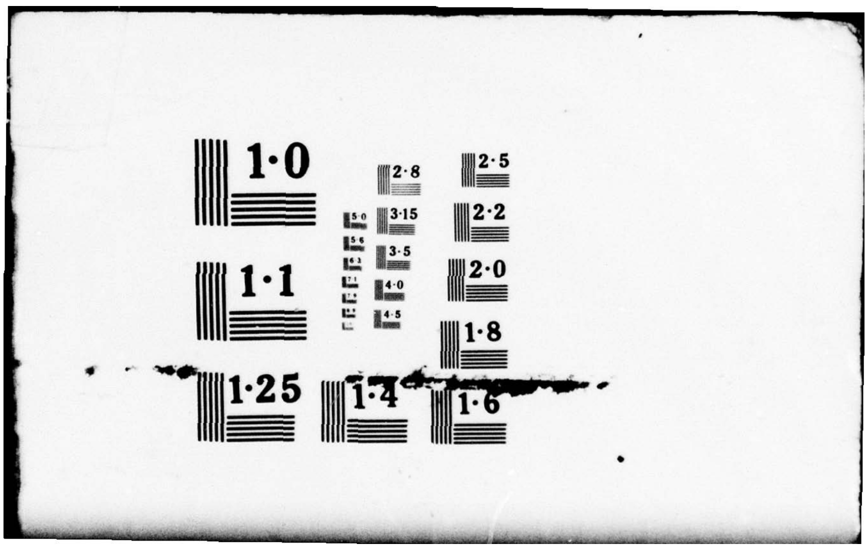
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Social Environment (1.2.3.5.11)

- The BMCA counties had a 1975 population of 738,500, about 5.5 percent of the Texas and New Mexico combined total.
- Urban BMCA counties had high rates of dwelling occupancy, rural counties—low rates.
- Median education completed in Texas BMCA counties averaged about 10-11 years, New Mexico BMCA counties—about 12 years.

Community Infrastructure (1.2.3.5.12)

- Present water withdrawals exceed recharge in every groundwater basin in this BMCA. Salt levels severely limit crop production.
- Electric generating capacity grew at the rate of 9.1 percent per year between 1965 and 1975 in Texas; production grew at a 7.2 percent rate; only 1.2 percent of 1975 production was hydroelectric. The Electric Reliability Council of Texas projects a 2,200 to 3,100 MW surplus generating capacity in this region in 1986 (DOE, 1978).
- Crude oil production in Texas accounts for 39 percent of U.S. production; New Mexico accounts for only 3 percent.
- The BMCA counties are traversed by I-10, I-20 and four U.S. highways.

Cultural Resources (1.2.3.5.13)

- A range of archaeological site types ranging from ephemeral hearthstone scatters to formal multi-room architectural structures may be expected to exist in the BMCA.
- Numerous sites have been recorded in the study area. A survey of 8,000 acres (3,200 ha) in El Paso County recorded 246 sites.
- Some sites occur well away from major drainages even in this semi-arid region.
- An absence of recorded sites in most of the Rio Grande Basin BMCA is the result of a lack of archaeological survey in that area.

Texas and New Mexico High Plains BMCA (1.2.3.6)

The Texas/New Mexico High Plains BMCA was selected as a sample of the geotechnically suitable areas in the High Plains. Figure 1-16 shows this sample area as well as other geotechnically suitable areas

Table 1-11. West Texas-Rio Grande Basin BMCA economic effects province* historic income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	2,628.5	4,024.7	5,230.3
	Per Capita Income[2]	2,635	4,004	4,778
	Relative Per Capita Income[3]	0.83	1.18	1.32
Earnings[1]	Total	2,196.4	2,008.8	2,622.5
	Farm	149.1	158.2	127.4
	Private Nonfarm	1,434.4	1,232.4	1,845.2
	Federal Government	388.8	377.0	363.8
	State and Local Government	224.1	241.2	286.1
Employment[4]	Total	224,380	248,229	280,560
	Farm	22,633	20,223	18,789
	Private Nonfarm	169,876	174,562	202,411
	Government	51,871	53,811	58,560
Labor Force and Unemployment[5]	Civilian Labor Force	NA	NA	304,000
	Unemployment	NA	NA	22,800
	Unemployment Rate (percent)	NA	NA	7.5

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[1] Millions of 1967 dollars.

[2] 1967 dollars.

[3] Area per capita divided by national per capita.

[4] Number of jobs.

[5] Annual average.

Sources: U.S. Bureau of Economic Analysis, 1977; New Mexico Employment Security Commission, 1978; Texas Employment Commission, 1978.

*The economic effects province is composed of Bureau of Economic Analysis economic areas 124 and 145. This includes Southern New Mexico and Southwestern Texas.

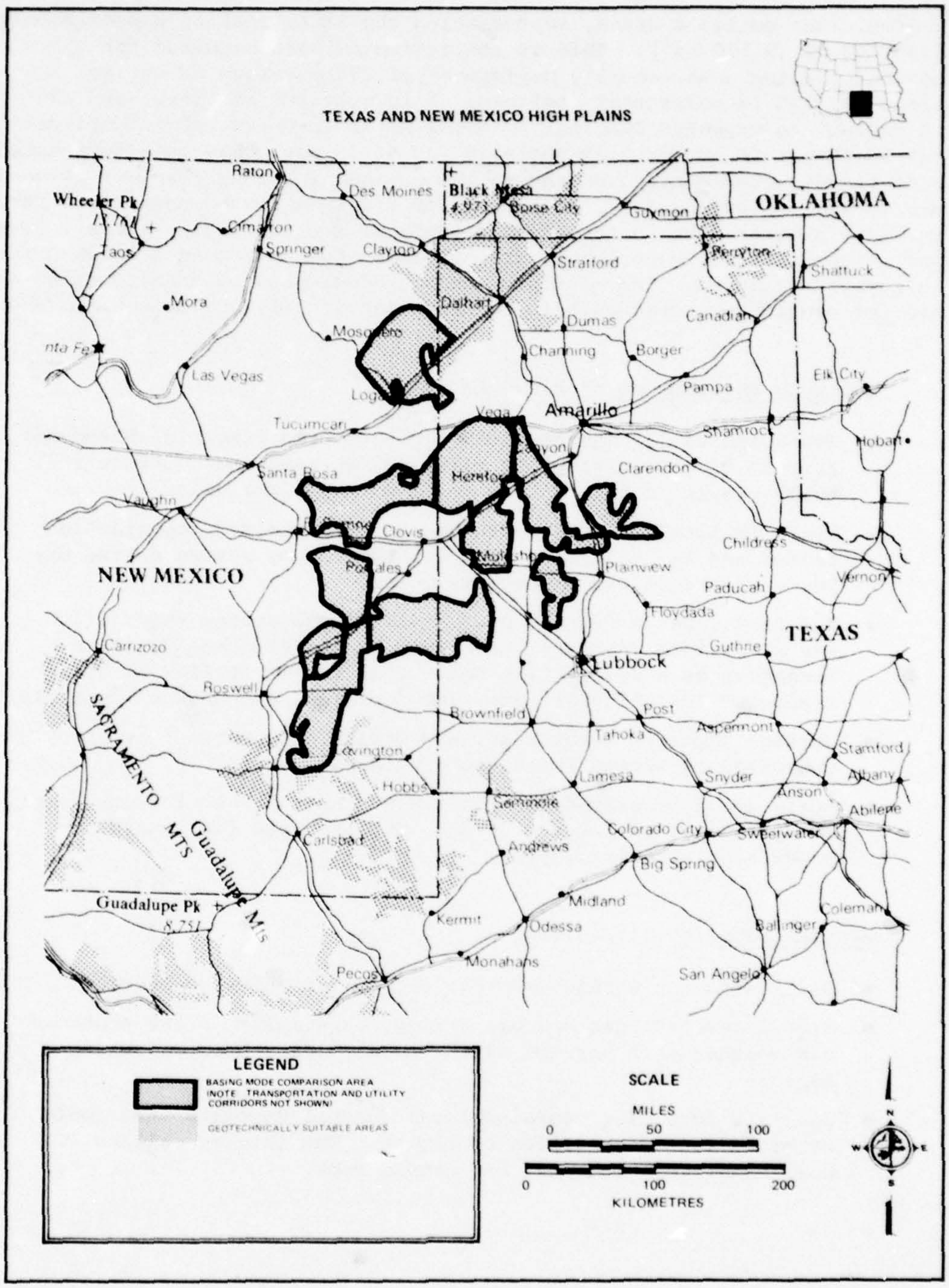

Figure 1-16. Texas and New Mexico High Plains basing mode comparison area.

nearby. The outlined areas, representing the BMCA, contain approximately 5,300 sq mi (8,500 km^2). This is the estimated area required for nominal spacing area security deployment of 115 missiles in buried trenches, 125 in horizontal shelters, 75 in vertical shelters, and 125 in pools. In expanded spacing, 70 missiles in trenches, 40 in horizontal shelters, 25 in vertical shelters and 45 in pools may be accommodated. Differences between modes depend on the nominal spacings (Table 1-1) used. Due to shallow groundwater, 10 percent of the area may be unsuitable for vertical shelters due to the greater depth of the vertical shelters. Transportation and utility corridors are not shown but have been accounted for in numbers deployed. The outlined areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

Geologic Environment (1.2.3.6.1)

- Topographically, the area is comprised of a flat old (Pliocene) surface that is covered by silty eolian sand and dotted with small playas, a few ft to a mi (2 m to 1.6 km) wide.
- There is little water erosion because of minimal topographic relief and low rainfall; wind erosion can be severe during dry years when dust and sandstorms occur.
- The landscape is covered by Quaternary calcareous sand, silt and playa lake deposits; underlain by the Pliocene Ogallala formation as a nearly flat deposit up to 350 ft (107 m) of coalesced low alluvial fans, flood plains, and channel deposits.
- Surface deposits (Quaternary and Ogallala formation) are poorly consolidated except for caliche hard-pan layers.
- Soils are generally deep, fertile and appropriate for dry farming of a limited range of crops, and are good for general crop production with irrigation.

Mineral Deposits (1.2.3.6.2)

- No significant surface mining, except for a few quarries.
- High-production gas and oil fields, especially in the southern and southeastern portion of the BMCA. (Palo Duro and Midland Basins).
- Ogallala formation contains local channel deposits that could be mined for construction aggregate. The thicker calicho (Ca Coz) beds could be mined for cement rock.

Surface Hydrology (1.2.3.6.3)

- Low precipitation (16 in. (40 cm)).
- Drainage is mostly local into playas rather than underground; weakly developed surface drainage system draining to east-southeast; essentially no runoff into the Brazos River except during years of exceptional rainfall.
- Surface water supply negligible.

Groundwater Hydrology (1.2.3.6.4)

- Ogallala formation is principal aquifer.
- Depth to groundwater varies from 50 to 200 ft (15 to 61 m); wells average about 500 gpm (1.9 m^3/min); supply should be sufficient to meet construction needs.
- Pumping has long exceeded recharge of the water table resulting in an average 30 ft (9 m) decline in the water table in 30-year period ending in 1957.
- No evidence of ground subsidence resulting from lowering of groundwater table.
- Estimated groundwater storage is about 60 million acre-ft (74×10^9 m^3).

Meteorology (1.2.3.6.5)

- A semi-arid climate with dry winters that is transitional between the desert to the west and the humid coastal regions farther east.
- Precipitation varies widely in location and amount through the year. Flash flooding is locally common.
- Tornados may occur in afternoon and evening hours from May through August.
- Duststorms occur most frequently in the spring and are associated with frontal passages.
- Good vertical mixing, low pollution potential.

Air Quality (1.2.3.6.6)

- Twenty-four hour particulate levels frequently exceed state and national standards. Sulfur dioxide and nitrogen dioxide levels remain well below standards. Ozone and carbon monoxide levels not available.
- No Mandatory Class I (no degradation permitted) areas lie within 50 mi (81 km) of the BMCA boundary.

Terrestrial Biology (1.2.3.6.7)

- Much of the BMCA has been cleared and is productive farmland under cultivation or is prime grazing land.
- Relatively low floristic diversity.
- Remaining natural flora is a subset of the widespread short-grass prairie of the Great Plains—essentially no floristic or faunistic features unique to the BMCA.
- Low faunistic diversity; existing fauna is a subset of Great Plains fauna with less diversity and lower game animal population levels than other Interior Division BMCAs because of lack of habitat diversity (no riparian vegetation or nearby hills or breaks).
- Diversity increases in northwest and west-central (near Santa Rosa, New Mexico) portions due to increasing topographic relief as well as increasing aridity. Southwestern portion is arid grassland and adjoins West Texas BMCA.
- Playa lakes are important habitat to migratory waterfowl along Central Flyway; some (Buffalo Lake NWR, Grulla NWR, Muleshoe NWR) have been designated as National Wildlife Refuges.
- Land use tends to shift from cropland to grazing land in western and southwestern portions of BMCA.
- Recovery rate of vegetation is moderately fast because dominant species are fast-growing grasses. Aridity places some restraints on recovery rate and in southwest portions desert scrub may invade following severe disturbance.

Aquatic Biology (1.2.3.6.8)

- Headwater reaches and tributaries of the Red, Brazos and Pecos Rivers traverse the BMCA, although most are impermanent. Buffalo Lake National Wildlife Refuge, in the Prairie Dog Town Fork of the Red River, also falls in the BMCA.
- Playa lakes are the major aquatic habitat.
- Floristic and faunistic diversity is limited because of harsh conditions (periodic drying; wide fluctuations in water level; general saline conditions and degradation of surface waters by agricultural runoff and oil field brines).
- Dominant fish include the redshiner (*Notropis lutrensis*), plains minnow (*Hybognathus placitus*), plains killifish (*Fundulus kansae*) and mosquito fish (*Gambusia affinis*), while larger fish such as the gizzard shad (*Dorosoma cepedianum*), carp (*Cyprinus*

carpio), river carpsucker (*Carpiodes carpio)*, and gray redhorse (*Moxostoma congestum*) also occur in suitably large aquatic habitats.

- Protected fish occur mostly in the Pecos River near Roswell and Fort Sumner, and Santa Rosa, in the Canadian River near the Texas border, and in Ute Creek near Mosquero.

Protected Species (1.2.3.6.9)

- Four state protected threatened reptiles are present in the BMCA: the sand dune sagebrush lizard, Texas horned lizard, Central Plains and Big Bend milksnakes.
- One federally proposed endangered plant species and one plant species under review as a threatened species occur near and possibly within the BMCA.
- Protected fish occur mostly in the Pecos River near Roswell and Fort Sumner, and Santa Rosa, in the Canadian River near the Texas border and in Ute Creek near Mosquero.
- Eleven fish and two frogs which are state protected as well as one federally protected fish (the Pecos Gambusia) may occur in or near the BMCA.

Economy (1.2.3.6.10) Table 1-12

- Agricultural earnings and employment are a dominant feature of the economic effect area, accounting for 9 percent of employment and 16 percent of earnings, five times the share this industry has in the U.S. economy. The value of agricultural products sold in 1974 averaged $86,700 per mi^2.
- Manufacturing employment and earnings contributed most to growth in the 1970-75 period. The largest employers are the food processing, electronics, apparel and construction machinery industries.

Social Environment (1.2.3.6.11)

- The BMCA counties had a 1975 population of 464,700, 3.4 percent of the total Texas and New Mexico populations, with a projected 1970-1990 growth rate of 1.3 percent per year. The overall density of the BMCA counties was 13.3 persons per mi^2, and the rural density was 3.5 persons per mi^2.

Table 1-12. Texas-New Mexico High Plains BMCA economic effects province* historical income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	5,489.2	5,984.1	7,125.1
	Per Capita Income[2]	2,610	2,931	3,182
	Relative Per Capita Income[3]	0.82	0.86	0.87
Earnings[1]	Total	4,540.0	4,858.9	5,632.2
	Farm	714.7	757.5	878.5
	Private Nonfarm	2,625.3	2,826.3	3,448.1
	Federal Government	693.2	619.3	619.8
	State and Local Government	506.8	655.8	685.8
Employment[4]	Total	633,745	646,911	743,845
	Farm	77,626	72,495	67,915
	Private Nonfarm	403,786	428,518	513,709
	Government	152,233	146,000	162,221
Labor Force and Unemployment[5]	Civilian Labor Force	NA	NA	805,900
	Unemployment	NA	NA	62,100
	Unemployment Rate (percent)	NA	NA	7.7

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[1]Millions of 1967 dollars.

[2]1967 dollars.

[3]Area per capita divided by national per capita.

[4]Number of jobs.

[5]Annual average.

Sources: U.S. Bureau of Economic Analysis, 1977; New Mexico Employment Security Commission, 1978; Texas Employment Commission, 1978.

*The economic effects province is composed of Bureau of Economic Analysis economic areas 122, 213, 145 and 146. This includes Western Texas and Northern New Mexico.

- School enrollment among the 5 to 17 year age group amounted to 94 percent of the group population in Texas in 1974, compared to 88 percent across the nation. Median education completed averages 11-12 years in BMCA counties.
- Occupancy rates of dwelling units in the BMCA counties was about 83.3 percent, well below the rate for both Texas and New Mexico as a whole.

Community Infrastructure (1.2.3.6.12)

- Water usage is outstripping sustainable supply. Severe problems are forecast for agriculture after the year 2015.
- Electric generating capacity in Texas grew at the rate of 9.1 percent per year between 1965 and 1975 in Texas and 8.5 percent in New Mexico; in Texas only 1.2 percent of production is hydroelectric, in New Mexico only 0.3 percent. The Southwest Power Pool Reliability Council projects a 2,500 MW deficit to a 3,900 MW surplus generating capability in this region in 1986 (DOE, 1978).
- Crude oil production in Texas accounts for 39 percent of U.S. production; New Mexico accounts for only 3 percent.
- The BMCA counties are traversed by I-40, I-27 and three U.S. highways.
- It is probable that most of the BMCA was never permanently occupied. Instead it served as a hunting area for a number of different cultural groups through time.
- Semipermanent base camps are expected around the periphery of the Liano Estacado. Sites on the Liano Estacado tend to be temporary campsites or kill sites.

South Platte Plains BMCA (1.2.3.7)

The South Platte Plains BMCA was selected as a sample of the geotechnically suitable areas in the Great Plains. Figure 1-17 shows this sample area as well as other geotechnically suitable areas nearby. The outlined areas, representing the BMCA, contain approximately 5,300 square miles (8,500 km^2). This is the estimated area required for nominal spacing area security deployment of 130 missiles in buried trenches, 145 in horizontal shelters, 85 in vertical shelters and 140 in pools. In expanded spacing, 80 missiles in trenches, 45 in horizontal shelters, 30 in vertical shelters and 50 in pools can be accommodated. Differences between modes depend on the nominal spacings (Table 1-1) used. Due to shallow groundwater, 60 percent of the area may be unsuitable

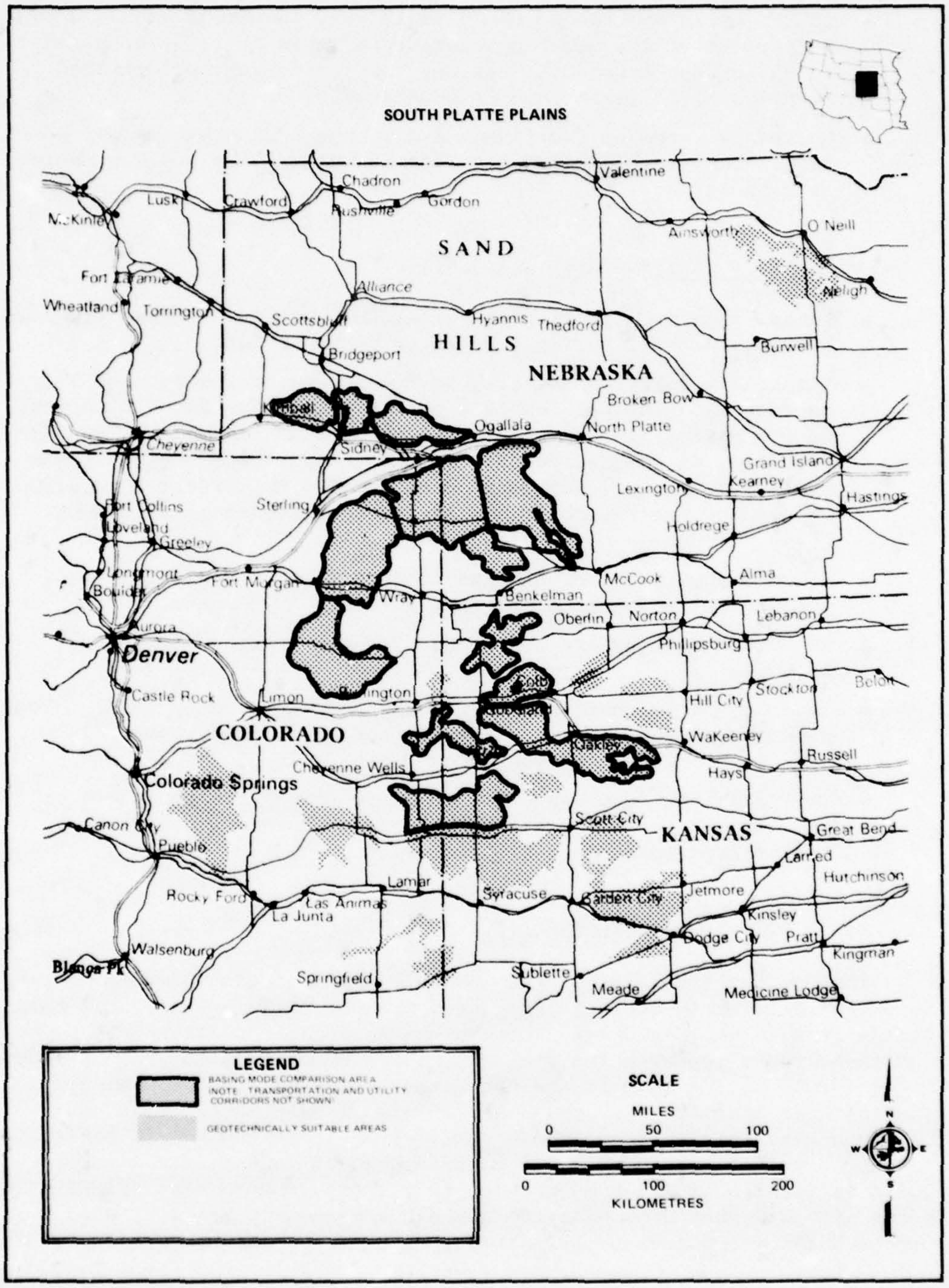


Figure 1-17. South Platte Plains basing mode comparison area.

for vertical shelters. Transportation and utility corridors are not shown but have been accounted for in numbers deployed. Numbered areas are examples of area required and are not considered preferable to other geotechnically suitable areas shown.

Geologic Environment (1.2.3.7.1)

- Terrain is flat to gently rolling plains and tablelands dissected in the vicinity of major rivers where steep terraces and bluffs occur.
- Drainage by five easterly flowing rivers with trellis-pattern tributaries.
- The major rock unit comprising the BMCA is the Pliocene Ogallala formation composed of fluvial deposits. Some Miocene/Ogliocene exposures occur along the Platte River bluffs. A thick Crotaceous series dominates the subsurface.
- Quaternary deposits are limited to local river terraces and flood plains and to sand hills near the North Platte River. The area is undergoing an erosional cycle.
- Soils are relatively deep grassland soils with rather high carbonate content. Their major use is for grazing and haymowing with limited areas of dry farming. Irrigated agriculture has increased in recent years with the growth of center pivot irrigation.

Mineral Resources (1.2.3.7.2)

- Numerous oil and gas fields are present in the Julesberg-Denver basin portion of the BMCA.
- Gravels and sand for construction are of limited availability being restricted to major river terraces with sands available in dune systems.

Surface Hydrology (1.2.3.7.3)

- Major river is the South Platte.
- Average annual precipitation 16 to 19 in. (40 to 48 cm); estimated annual runoff is 1.7 in. (4.3 cm).
- 100-year flood peaks are ca. 7,400-10,000 cfs for 50 and 100 mi^2 (209 to 283 m^3/sec for 129.5 to 259 km^2) drainages respectively.

- Annual surface water supply is estimated at 2.7 million acre-ft (3.4×10^9 m^3) and estimated use is 1.9 million acre-ft (2.3×10^9 m^3). Excess may not be available due to prior rights.

Groundwater Hydrology (1.2.3.7.4)

- Alluvial aquifers yield good water at several hundred gpm (2.3 m^3/min).
- Estimated groundwater storage in upper 150 ft (48 m) is 20 million acre-ft (24.7×10^9 m^3).
- No evidence of subsidence associated with groundwater lowering.

Meteorology (1.2.3.7.5)

- Interior continental climate with light rainfall, low humidity, hot summers, and cold winters.
- The temperature range is from the 90s F (32°C) in summer to the low 'teens (-11°C) in winter.
- Annual precipitation averages about 15 in. (37 cm) with just over half falling as showers in the months of April through July.
- Winter precipitation is mainly snow and averages about 38 in. (95 cm) per year over the area. Ice storms occur approximately 4 to 8 days per year, with heavy snowstorms, 12 inches or more in 24 hours, occurring once or twice a year.
- Surface winds are from north to northeast and average about 14 knots.
- Tornadoes are infrequent but have occurred within the area in association with severe thunderstorms.
- Damaging winds and hail are often associated with intense thunderstorms, which occur periodically throughout the summer season.

Air Quality (1.2.3.7.6)

- Twenty-four hour particulate levels rarely exceed national standards. Sulfur dioxide, nitrogen dioxide and carbon monoxide levels all remain well below standards. Ozone levels not available for BMCA.
- No Mandatory Class I (no degradation permitted) areas lie within 50 mi (81 km) of the BMCA boundary.

Terrestrial Biology (1.2.3.7.7)

- Native vegetation is shortgrass prairie used for grazing, haymowing, and crop production, especially alfalfa.

- Disturbance is moderate, associated with the intensive use of the land for grazing and cropland. Grazing has profoundly affected the species composition and dominance in the grassland.
- Plant succession or revegetation of cleared areas expected to occur relatively rapidly with reestablishment of a good perennial grass cover expected in five to ten years. Aridity factor has been least influential on this BMCA.
- Plant growth-form diversity and species richness are low; no regionally unique habitat within BMCA: prevailing grassland type is widespread in the Great Plains.
- BMCA contains an excellent representation of Great Plains fauna with the rather extensive occurrence of river breaks and riparian vegetation contributing to both faunal diversity and population sizes.

Aquatic Biology (1.2.3.7.8)

- Major aquatic habitats are the turbid major rivers and their tributaries and intermittent ponds.
- There are four rivers within a few miles of the BMCA boundaries. These are the South Platte, North Platte, Smoky Hill and the South Fork of the Republican River.
- The southern region of the BMCA has less well developed drainage patterns. There are several small, shallow, alkaline prairie lakes here. They are usually eutrophic and dominated by blue green algae (Cyanophyta). The predominant fish is the alkali-tolerant fathead minnow (*Pimephales promelas*).
- The highly turbid rivers and streams in the northern part of the BMCA contain a wide variety of fish species, particularly several shiners (*Notropis* spp.), fathead minnows, white suckers (*Catostomus commersoni*) and carp (*Cyprinus carpio*).
- However, many native clear water fishes like the blacknose dace (*Rhinichthys artratulus*), highfin carpsucker (*Carpoides velifer*) and golden redhorse (*Moxostoma erythrurum*)have been eliminated due to increasing silt pollution.

Protected Species (1.2.3.7.8)

- The black footed ferret on the federal endangered species list may be present in the BMCA.
- The swift fox, greater prairie chicken, and shap-tailed grouse are present in the BMCA and considered endangered species by at least one of the BMCA states.

- The lesser prairie chicken is classified as threatened by Colorado and the mountain plover is classified as threatened by Nebraska.
- No federally proposed endangered plant species or plant species under review as threatened species are known to occur in the BMCA.
- No federally or state protected aquatic biota occur in the BMCA.

Economy (1.2.3.7.10) Table 1-13

- BMCA economic area centered on the Denver metropolitan complex. Agriculture is important but not dominant in the area.
- Both employment and earnings grew at over twice the national rate between 1967 and 1975.
- BMCA counties highly agricultural with increasing use of center-point irrigation. The value of agricultural products sold in 1974 averaged \$41,100 per mi^2.

Social Environment (1.2.3.7.11)

- BMCA counties had population of 200,200 in 1975 and projected annual growth of 0.3 percent through 1990. The overall density of the BMCA counties was 5.2 persons per mi^2, and the rural density was 3.7 persons per mi^2.
- Median school years completed for BMCA counties was about 12.
- Housing occupancy generally lower than state averages.

Community Infrastructure (1.2.3.7.12)

- Water resources will be sufficient for projected future if managed carefully.
- The Western Systems Coordinating Council projects a 7,000 to 19,500 MW surplus generating capability in this region in 1986 (DOE, 1978).
- Three interstate highways, I-70, I-80 and I-76 pass through or run close to the BMCA with several railroad lines passing through parts of the area.

Cultural Resources (1.2.3.7.13)

- Archaeological sites are expected to be concentrated along drainage systems.

Table 1-13. South Platte Plains BMCA economic effect province* historical income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[1]	6,690.0	7,832.0	9,319.9
	Per Capita Income[2]	3,049	3,387	3,688
	Relative Per Capita Income[3]	0.96	1.00	1.02
Earnings[1]	Total	5,264.4	6,118.9	7,701.4
	Farm	606.6	730.7	934.3
	Private Nonfarm	3,739.0	4,323.0	5,456.6
	Federal Government	364.2	412.0	459.6
	State and Local Government	554.6	653.2	850.9
Employment[4]	Total	922,892	1,009,919	1,197,322
	Farm	112,420	105,033	103,674
	Private Nonfarm	640,941	721,398	873,581
	Government	169,531	183,488	220,067
Labor Force and Unemployment[5]	Civilian Labor Force	NA	NA	1,269,700
	Unemployment	NA	NA	72,400
	Unemployment Rate (percent)	NA	NA	5.7

372T-4008

[1]Millions of 1967 dollars.

[2]1967 dollars.

[3]Area per capita divided by national per capita.

[4]Number of jobs.

[5]Annual average.

Sources: U.S. Bureau of Economic Analysis, 1977; Colorado Division of Employment, 1978; Kansas Employment Security Division, 1978; Nebraska Department of Labor, 1978.

*The economic effects province is composed of Bureau of Economic Analysis economic areas 101, 102, 109 and 148. These include southeastern Colorado, northwestern Kansas and western Nebraska.

- A range of site types from village sites to lithic sites are likely to occur in the BMCA.
- Historic sites are likely to include army posts, stage stations, and ranch or farmhouses.

Minuteman III MAP Northern Basing (1.2.3.8)

A multiple aimpoint (MAP) system using the Minuteman III (MM III) in some of the present MM III Wing areas might be considered as an alternative to MX. This is a very different project than MX Southwest basing and some revised estimates are necessary to describe the project.

The missiles were assumed to be distributed in wings as they are today except for Wing I, which might cause construction problems. Therefore, distribution is:

Wing III	(Minot AFB)	175 MM III	3,500 Aimpoints
Wing V	(Warren AFB)	200 MM III	4,000 Aimpoints
Wing VI	(Grand Forks AFB)	175 MM III	3,500 Aimpoints

See Figure 1-18 for locations.

Geologic Environment (1.2.3.8.1)

Grand Forks Wing

- An average slope of 9 to 10 ft per mile (2 m per km) is the topographic representation from the glaciated plain bisected by the Red River to the westerly-trending upland areas that rise to a long, north-south tableland series of glacial mosaines.
- The Red River Valley is actually the site of the Pleistocene glacial Lake Agassig. The old lakebed slopes gently inward at about 3 to 10 ft per mile (0.6 to 1.9 m per km) toward its central point along the North Dakota/Minnesota border.
- The soils of the region are of post-Ice Age derivation and closely resemble glacial drift and till. Classified generally as Mollisols, the soils are further divided into Borolls (cool, moist) and Aquolls (wet) sub-groups.
- Two kinds of sedimentary rocks, no igneous rocks, are found: glacial materials of Pleistocene age and stratified marine deposits of the Cretaceous. There are only a few places where the glacial deposits are absent, such as along the banks of the Pemgina, Park, and Cheyenne Rivers where the Pierre (Cretaceous) formation is exposed.

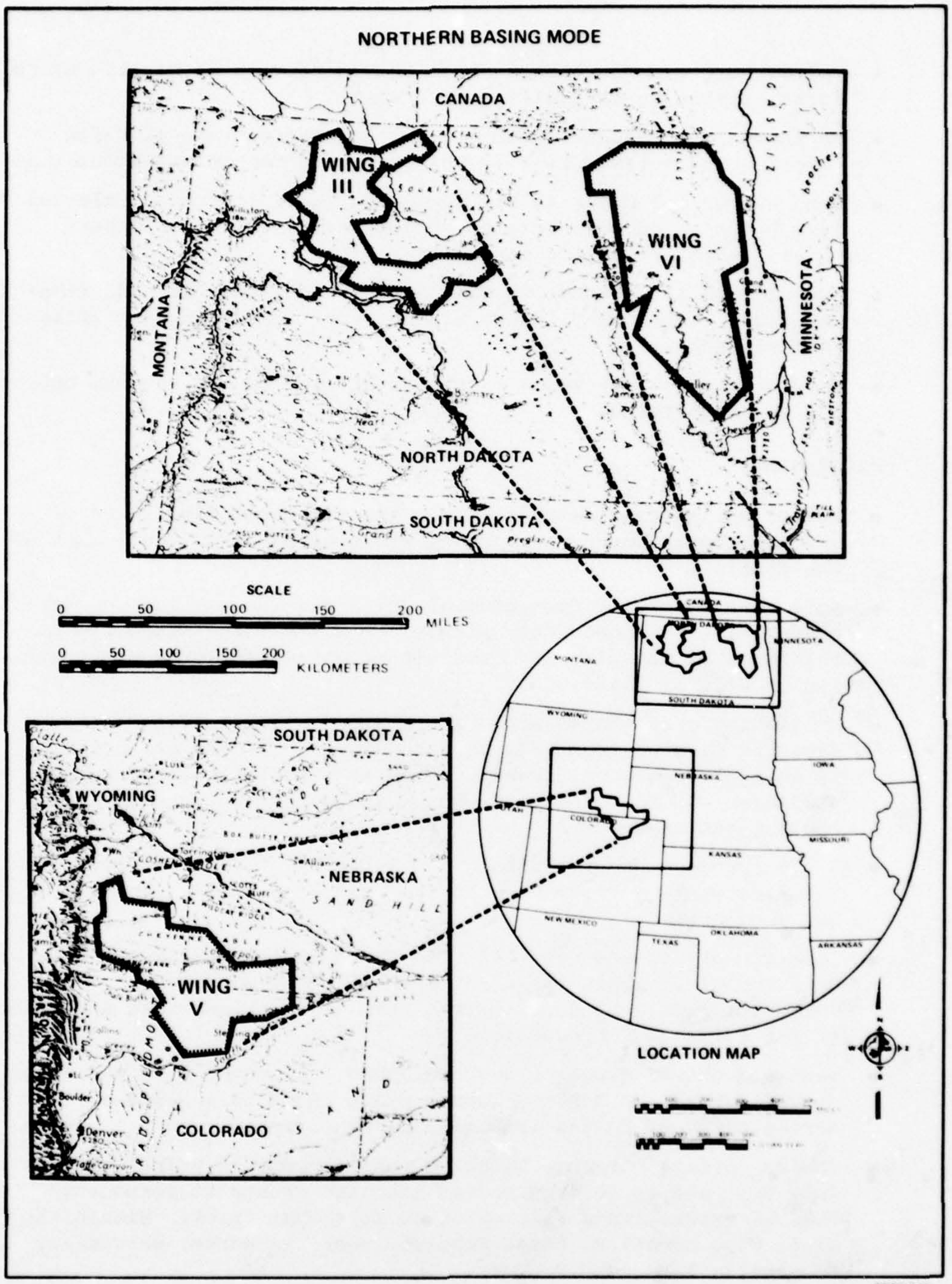


Figure 1-18. MM III locations.

- Solid, hard bedrock occurs at about 330 ft (100 m) beneath Grand Forks, deepening gradually to the west.
- No known large faults occur within the entire state of North Dakota. The seismic risk is the lowest in the conterminous U.S.
- Sand and gravel deposits are common in stream terraces, glacial lake beaches, out-wash plains, old riverine channels, espers, pames, and morainal pockets.
- Cement rock (limestone) is available in both Cavalier and Pembina Counties. Ironically, there are no cement producing facilities in North Dakota.
- Several exploratory wells have been drilled in the region, but no oil has been found.

Minot Wing

- Relief varies considerably within the limits of dissection of glacial topography by a confused riverine pattern (e.g., such as the Souris).
- Soils are developed from glacial drift and are similar in characteristics to those found within the Grand Forks Wing, except that some of the clay is mixed with a white, efflorescent coating of Glauber Salts.
- Unlike the Grand Forks area, there are occurrences of Tertiary deposits ranging from Paleocene to Miocene. These are overlain by an appreciable thickness of glacial material, albeit Eocene exposures can be found in Mountrail and McKenzie Counties within the subject area.
- A rich procession of Mesozoic and Paleozoic rocks underlie the Tertiary with westerly dips to the Williston Basin. These are oil productive.
- Location of oil and gas fields in Burke, Bottineau, Mountrail, and Ward Counties within the Minot Wing siting area could have decided impact. Production from this area is less than 1 percent of the total U.S. production.
- Sand and gravel deposits are available. An example is the large gravel deposit in McHenry County where the Souris River built a series of broad deltas into glacial Lake Souris.
- Sodium sulfate (Glauber Salts) deposits occur in brine lakebeds (now dry) and range from mud-adulterated crusts to permanent beds of crystallized salt up to 80 ft (24 m) thick. Within the Minot Wing counties, these deposits occur in Burke, Bottineau, Mountrail, Ward, and McHenry.

- Some of the best coal in western U.S. comes from the northwesterly region of North Dakota, within a good portion of the subject area in Burke, Dendville, Mountrail, Ward, and McLean Counties.
- Production of coal for North Dakota for 1977 averaged slightly over 1 million tons monthly.
- No seismic risks are involved.

Warren Wing

- Located in Wyoming within the triangular confluence of the North and South Platte Rivers, the subject area includes a portion of northeast Colorado and southwest Nebraska.
- Topography is characterized by greatly rolling plains and tableland, bounded on the west by the foothills of the Rockies.
- Quaternary deposits occur along stream terraces and the flood plains of both rivers.
- The major formational units exposed are fluvial deposits of the Pleocene Ogallala formation that are richly calcareous. Miocene and Oligocene units, made up of siltstone and sandstone, occur along the high river bluffs.
- Rippable rock material can be anticipated to depths exceeding 50 ft (15 m).
- Soils are derived mainly from the ubiquitous formational units and tend to be high in $CaCO_3$.
- Grassland soil types and shallow groundwater quality restrict agricultural use of the land to grazing, hay-growing, with limited areas of dry farming.
- The local soils, when dry, tend to wind erode with an abundance of fine particulates.
- There is relatively little seismic risk, albeit earthquakes have occurred in the Denver area some 70 miles (112 km) to the south. A seismic probability of horizontal acceleration not exceeding 0.04 g is estimated.
- Oil and gas fields are located within the subject area, such as Venter Oil Field in Logan County, Colorado.
- There is no known coal production in the Warren Wing area, although sub-bituminous production is known closely proximal to the south.

Mineral Resources (1.2.3.8.2)

Grand Forks Wing

- Sand and gravel deposits are common.
- Cement rock (limestone) available but no cement plants exist in the area.

Minot Wing

- Large bituminous coal production [1977 - 12 million tons (11 million metric tons)]
- Some oil and gas fields in the deployment area
- Sand gravel and sodium sulfate deposits fairly common

Warren Wing

- Oil and gas fields in the deployment area
- Sub-bituminous coal production immediately south of present Wing area

Surface Hydrology (1.2.3.8.3)

Grand Forks Wing

- The site is in the Red River Basin
- Average precipitation is about 21 in. (53 cm) per year, most of it occurs during the growing seasons.
- The basin is characteristic of glacier drift
- The area is prone to periodic flooding
- Severe flooding occurs in the early spring

Minot Wing

- The site is located by Lake Sakakawea and on both sides of the Missouri River
- Water supply would be of no problem
- Average precipitation is about 15 in. (38 cm), of which only 4 in. (10 cm) come in the form of snow.
- The surface water is much regulated by Garrison Dam on Missouri River

- Severe river bed and river bank erosion occurred since the completion of Garrison Dam
- Water release downstream of Garrison Dam is determined primarily by the needs for electrical power generation

Warren Wing

- The site is situated in the Platte River watershed
- Average annual precipitation is about 15 in. (38 cm); rainfall and snow pack varies greatly depending on the terrain.
- Water availability is more a legal problem than a physical one
- Site is in a groundwater control zone
- Periodic flooding can be expected
- Wind erosion is a problem in the area; sheet flow erosion is minor

Groundwater Hydrology (1.2.3.8.4)

Grand Forks Wing

- Sandstone aquifers yielding over 50 gpm underly most of the western 80 percent of the area
- Major river bottoms have thick gravel and sand aquifers yielding copiously
- Well depths range from several hundred to over 1,000 ft
- Nearly all groundwater is already allocated to municipal and industrial and agricultural uses
- Moderate concentrations of dissolved minerals are present, usually in the range of 3,000 to 10,000 ppm
- Most rural domestic water supplies are from wells and do not meet municipal minimum purity levels
- Water tables have not been severely lowered by current usage

Minot Wing

- No major aquifers within the region
- Aquifers within the region are composed of glacial outwash materials
- Depth to water less than 500 ft with 1,000 to 3,000 ppm of dissolved minerals

Warren Wing

- Aquifers chiefly comprised of sand and gravel, and sandstone
- Minerals in the groundwater range from 3,000 to 10,000 ppm
- Well yield of at least 50 gallons per minute or 3.5 litre per second

Meteorology (1.2.3.8.5)

- Interior continental climate with severe winter temperatures, moderate summer temperatures and a seasonal distribution of rainfall.
- Precipitation averages about 15 in. (38 cm) per year with about 80 percent falling as showers during the months of April through October.
- Spring floods due to melting snow are common but summer floods caused by high intensity precipitation is infrequent.
- Heavy winter snowfalls are uncommon but severe blizzards causing much drifting and substantial visibility reductions even with a light snowfall, occur periodically during the winter season as a result of strong winds.
- Surface winds are from the north to northwest and average about 11 knots.
- A high frequency of duststorms occur during the spring and summer months occasionally associated with thunderstorms.
- Moderate mixing depth and high mean wind speeds produce good dispersion conditions throughout all seasons.

Air Quality (1.2.3.8.6)

- Twenty-four hour particulate levels rarely exceed national standards. Sulfur dioxide, nitrogen dioxide, and carbon monoxide levels all remain well below standards. Ozone levels not available in Northern Basing Mode region.
- Rocky Mountain National Park. A mandatory Class I (no degradation permitted) area lies approximately 50 mi (81 km) from the Warren AFB basing mode.

Terrestrial Biology (1.2.3.8.7)

- Native vegetation is largely shortgrass and mixed grass prairie with small areas of tall grass prairie in the Grand Forks Wing.
- Much of land area in the North Dakota wings is irrigated and non-irrigated cropland, especially wheat.
- Grazing use of rangeland predominates at Warren and is common in the Minot Wing.
- Floral and faunal diversity is relatively low in all three areas and is typical of Great Plains areas.
- Revegetation of cleared areas is fairly rapid with establishment of perennial grasses within 5-10 years. Revegetation would occur most quickly in Grand Forks, least rapidly in the Warren Wing.

Aquatic Biology (1.2.3.8.8)

- Major aquatic habitats are rivers (e.g., Souris, South Platte, Cheyenne) and a variety of impoundments (e.g., Lake Sakakawea) and small lakes.
- Most of the lakes and reservoirs are productive, moderately high in carbonates and support warm water fisheries.

Protected Species (1.2.3.8.9)

- The federally endanger black-footed ferret may be present in the Minot or Cheyenne Wings.
- Each wing contains at least one state protected bird species (Grand Forks: greater prairie chicken, Minot: prairie falcon, Cheyenne: burrowing owl).
- The Cheyenne Wing includes three state protected fishes: the suckermouth minnow, hornyhead chub and common shiner.

Economy (1.2.3.8.10)

Minot Wing (Table 1-14)

- The Minot economic effects province is dominated by two urban centers, Minot and Bismarck. However, neither urban area comprises a large population.
- Total employment growth of 0.7 percent per year between 1967-1970 was minimal, but it increased to an annual rate of 2.4 percent over the succeeding five years, roughly twice that of the U.S. over the same period.
- Private non-farm employment, comprising the majority of the total, grew rapidly over the entire 1967-1975 period. Farm employment, however, declined 14 percent throughout the period.
- Per capita income equaled $3,190 in 1975, but has remained historically less than the national average.
- There was no growth in earnings between 1967-1970. Over the succeeding five years, however, earnings' growth was very rapid, average annual growth equaled 4.8 percent per annum.
- Within the 1970-1975 period, farm earnings grew most rapidly, 6.2 percent per year, but were closely followed by private non-farm earnings. However, of the two, only non-farm earnings' share of the total rose consistently over the entire 1967-1975 period.

Grand Forks Wing (Table 1-15)

- The Grand Forks economic effect province is dominated by the Fargo-Moorhead SMSA.
- Total employment grew at a modest annual rate of 1.2 percent per year between 1967-1970, but jumped to 3.1 percent per annum over the 1970-1975 period. This rate of growth was well over the two times the national average rate of growth.
- Private non-farm employment, comprising the majority of the total, grew rapidly over the entire 1967 - 1975 period. Farm employment, on the other hand, declined between 1967-1970, and increased only slightly in the succeeding five years.

Table 1-14. Minot wing economic effects province[1] historic income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[2]	538.80	563.60	731.20
	Per Capita Income[3]	2,388.00	2,533.00	3,216.00
	Relative Per Capita Income[4]	0.75	0.75	0.88
Earnings[3]	Total	416.20	429.20	552.90
	Farm	116.30	102.20	139.20
	Private Nonfarm	224.10	239.50	323.30
	Federal Government	23.80	25.70	30.20
	State and Local Government	52.00	61.80	90.40
Employment[5]	Total	91,628.00	94,076.00	107,155.00
	Farm	25,961.00	24,274.00	22,298.00
	Private Nonfarm	47,041.00	51,287.00	63,857.00
	Government	18,626.00	18,515.00	21,000.00
Labor Force and Unemployment[6]	Civilian Labor Force	NA	NA	128,272.00
	Unemployment	NA	NA	6,413.00
	Unemployment Rate (percent)	NA	NA	5.00
Population	Population (Thousands)	225.60	222.50	227.30

[1]The economc effect province is composed of Bureau of Economic Analysis economic areas 93 and 96.

[2]Millions of 1967 dollars.

[3]1967 dollars.

[4]Area per capita divided by national per capita.

[5]Number of jobs.

[6]Annual average.

Sources: Bureau of Economic Analysis, 1977; North Dakota Department of Labor, 1978.

Table 1-15. Grand Forks wing economic effects province[1] historic income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[2]	1,356.30	1,479.40	2,051.50
	Per Capita Income[3]	2,432.00	2,653.00	3,573.00
	Relative Per Capita Income[4]	0.76	0.78	0.99
Earnings[3]	Total	1,031.70	1,109.90	1,583.20
	Farm	241.00	226.40	536.90
	Private Nonfarm	567.50	635.70	776.90
	Federal Government	83.70	91.90	99.30
	State and Local Government	139.40	155.90	170.10
Employment[5]	Total	223,758.00	232,041.00	270,252.00
	Farm	59,256.00	54,534.00	57,352.00
	Private Nonfarm	114,714.00	126,921.00	156,540.00
	Government	49,788.00	50,586.00	56,360.00
Labor Force and Unemployment[6]	Civilian Labor Force	NA	NA	323,389.00
	Unemployment	NA	NA	16,169.00
	Unemployment Rate (percent)	NA	NA	5.00
Population	Population (Thousands)	557.80	557.70	574.20

[1]The economic effects province is composed of Bureau of Economic Analysis economic areas 92 and 97.

[2]Millions of 1967 dollars.

[3]1967 dollars.

[4]Area per capita divided by national per capita.

[5]Number of jobs.

[6]Annual average.

Sources: Bureau of Economic Analysis, 1977; North Dakota Department of Labor.

- Per capita income equaled $3,573 in 1975, and has always been less than the U.S. average over 1967-1975. However, it increased from 76 percent in 1967 to 1975's 99 percent of U.S. per capita income.
- Earnings grew at an exceptionally rapid rate between 1970-1975, 7.4 percent per year. Over this same period, farm earnings grew most rapidly, over two times that of total earnings. Farm earnings' share of the total increased from 23 percent in 1967, to one-third of total earnings by 1975.

Warren Wing (Table 1-16)

- The Warren economic effect province is dominated by the Denver SMSA.
- The area's economy grew at approximately one and one-half times the national annual average rate of growth.
- Agriculture (principally livestock and wheat production) is an important source of income and earnings but not dominant in the area. Employment in this sector decreased 7.8 percent between 1967 and 1975.
- State and local government is the fastest growing economic division in the economy (annual average rate of growth, 616 percent).
- The 1975 unemployment rate (4.0 percent) is one-half the national rate.
- Per capita income relative to the U.S. average was 1.01 in 1975, up from 0.97 in 1967.

<u>Social Environment</u> (1.2.3.8.11)

Minot Wing

- Population of the BMCA counties in 1975 was 106,900; about 4.45 percent of this population resided in urban areas. The overall density was 9.3 persons per square mile.
- The median level of education completed by adults in BMCA counties was 11.5 years in 1970.
- Housing occupancy rates in the North Dakota BMCA counties in 1970 were about 91.5 percent. This was slightly more than the State of North Dakota occupancy rate of 90.6 percent.

Table 1-16. Warren AFB wing economic effects province[1] historic income and employment indicators.

INDICATOR		1967	1970	1975
Income	Total Personal Income[2]	5,411.00	6,416.80	7,703.50
	Per Capita Income[3]	3,099.00	3,431.00	3,666.00
	Relative Per Capita Income[4]	0.97	1.01	1.01
Earnings[3]	Total	4,377.40	5,288.80	6,578.30
	Farm	234.80	439.70	350.80
	Private Nonfarm	3,282.30	3,860.20	4,968.10
	Federal Government	374.70	424.60	481.80
	State and Local Government	485.60	564.30	777.60
Employment[5]	Total	279,984.00	814,825.00	991,246.00
	Farm	47,268.00	44,908.00	43.554.00
	Private Nonfarm	532,318.00	607,030.00	747,780.00
	Government	150,398.00	162,887.00	199,912.00
Labor Force and Unemployment[6]	Civilian Labor Force	NA	NA	1,033,127.00
	Unemployment	NA	NA	41,881.00
	Unemployment Rate (percent)	NA	NA	4.00
Population	Population (Thousands)	1,745.80	1,820.00	2,101.00

[1]The economic effects province is composed of Bureau of Economic Analysis economic areas 101, 148, and 150.

[2]Millions of 1967 dollars.

[3]1967 dollars.

[4]Area per capita divided by national per capita.

[5]Number of jobs.

[6]Annual average.

Sources: Bureau of Economic Analysis, 1977, Wyoming Division of Employment, 1978, Colorado Division of employment, 1978, Nebraska Department of Labor, 1978.

Grand Forks Wing

- Population of the BMCA counties in 1975 was 271,700; about 57.0 percent of this population resided in urban areas. The overall density was 17.2 persons per square mile.
- The median level of education completed by adults in BMCA counties was 11.6 years in 1970.
- Housing occupancy rates in the BMCA counties in 1970 were about 89.9 percent. This is slightly less than the State of North Dakota occupancy rate of 90.6 percent.

Warren Wing

- Population of the BMCA counties in 1975 was 226,200; about 56.0 percent of this population resided in urban areas. The overall density was 14.4 persons per square mile.
- The median level of education completed by adults in BMCA counties was 12.3 years in 1970.
- Housing occupancy rates in the BMCA counties in 1970 were about 93.0 percent. This is slightly more than the State of Wyoming occupancy rate of 91.3 percent.

<u>Community Infrastructure</u> (1.2.3.8.12)

Minot Wing

- The State of North Dakota had an electric generating capacity of 1,267 megawatts in 1975, having increased at a rate of 5.3 percent per year since 1965. Production of electricity was 75.8 percent of capacity, an increase of about 9.8 percent per year since 1965. Oak Ridge projects a slight 1985 generating capacity surplus for the BMCA counties area.
- Water supplies in the BMCA counties area are generally very adequate for future urban growth and quality is very good.
- The BMCA counties are traversed by U.S. 2, U.S. 52, and U.S. 83, in addition to three railroad lines.

Grand Forks Wing

- The State of North Dakota had an electric generating capacity of 1,267 megawatts in 1975, having increased at a rate of 5.3 percent per year since 1965. Production of electricity was 75.8 percent of capacity, an increase of about 9.8 percent per year since 1965. Oak Ridge projects a 1985 generating capacity deficit for the BMCA counties area.
- Water supplies in the BMCA counties area are generally very adequate for future urban growth and quality is excellent.
- The BMCA counties are traversed by I-94, I-29, U.S. 2, and U.S. 81, in addition to two railroad lines.

Warren Wing

- The State of Wyoming had an electric generating capacity of 2,863 megawatts in 1975, having increased at a rate of 12.3 percent per year since 1965. Production of electricity was about 48.7 percent of capacity, an increase of about 12.6 percent per year since 1965. Oak Ridge projects a generating capacity deficit for most of the BMCA counties area.
- Water supplies in the BMCA counties area are generally adequate for future urban growth and quality is good.
- The BMCA counties are traversed by I-80, I-25, U.S. 85, and U.S. 385, in addition to three railroad lines.

Note: It should be noted in all of the above discussion that the availability of water and the allocation of water rights are governed by the general principals and codified provisions of Western water law.

Land Use

2

RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

2.1 AREA SECURITY RELATIONSHIP

Deployment of any of the four basing mode options, in the area security configuration may have large impact on current land use for the life of the project and, potentially, on land use after decommissioning. The largest impact on land use will result from exclusion of all alternative users from the deployment area for the life of the project. Since the fenced area is quite large [between 4,000 and 19,100 mi^2 (10,400 and 49,500 km^2)], a variety of exisitng and potential users are certain to be excluded. The type of land use and, therefore, the impact is strongly site-dependent.

In the intermontane regions of the west, existing land ownership is largely federal, and deployment could interfere with alternative activities, particularly with activities of the Department of Defense and the Bureau of Land Management (BLM). BLM has been developing detailed land use plans in California, Nevada, Arizona, and New Mexico, including some of the potential deployment areas, and deployment would render these plans moot. Removal of the land from mineral exploitation or from grazing would constitute the most serious economic impacts in this area. In the Great Plains, on the other hand, much of the land is in private ownership, and frequently, is crop or grazing land. In addition, much of it is inhabited. Deployment in these areas would require purchase of land and exclusion of farmers and ranchers, many of whom currently live on the land. The economic impact would largely result from loss of these activities.

2.2 POINT SECURITY RELATIONSHIP

The effects of the point security configuration for the shelter or pool options will be somewhat different from area security regarding land use. Point security for the MX only requires 3-5 acres (1-2 ha) per aimpoint from which alternate users are completely excluded. For

5,000 aimpoints this is about 20-40 mi^2 (52-104 km^2) of fenced area. In addition, 90 to 250 mi^2 (233 to 650 km^2) will be required for roads. However, around each aimpoint a restrictive clear zone easement is required which extends out to a distance of 2,965 ft (904 m). This amounts to about 1 mi^2 (2.6 km^2) per aimpoint. Agriculture, recreation and similar uses could continue in this zone but no habitable structures would be allowed. Unless a great deal of care were used in siting the aimpoints people would be relocated and mining operations would cease or be deferred in total areas of size similar to those of area security configurations. The difference between area and point security, regarding homes and mining, is that point security aimpoints can be sited to minimize disturbance to people and mining operations.

2.3 LAND USE SUMMARY

A summary of land status in the seven BMCAs follows:

Central Nevada Great Basin BMCA

- almost all BLM
- large areas of relatively undisturbed natural vegetation present
- primary existing use is cattle grazing
- small amount of cultivation in several discrete areas
- mineral production secondary, but primarily in mountains, access to which could be blocked
- recreation use moderate, revolves around hunting, fishing, and "vastness"
- few roads, no railroads
- very low population density
- future land use probably the same as existing land use; therefore, recovery is probable
- land-use plans are being developed; BLM tends toward multiple use

California Mojave Desert BMCA

- some private ownership, but much is under BLM
- relatively small areas pristine, those largely in mountains or National Parks or Monuments
- some agricultural production, availability of water is limiting in this area
- dairy products, livestock, and poultry important
- some mining

- two interstate highways in area
- major rail lines
- some petroleum product and natural gas pipelines
- population density moderate
- high recreation usage
- present BLM-use plans are for multiple use

Luke/Yuma BMCA

- land mostly under BLM with some DOD and private ownership
- large pristine areas due to military withdrawal and lack of water
- private land predominantly agricultural
- mineral reserves exist, but mining currently not intense
- several natural gas pipelines
- rural population density very light
- current land-use plans tend toward agriculture and recreation
- recreational use low to moderate, but increasing

White Sands BMCA

- except for the Missile Range proper, land is mainly under BLM with some private ownership
- primary land use is cattle grazing
- cultivation intensive along Rio Grande River
- little mineral value
- one interstate highway and some rail networks
- one oil pipeline
- population density moderate
- BLM plans for land use are multiple use
- recreational use moderate, concentrated in mountains and along Rio Grande

West Texas BMCA

- land mostly privately owned
- grazing and cattle production, but not intensive
- water availability limited

- oil and gas pipelines present
- one interstate highway and several railroads
- population density very light
- no current land-use plans
- recreational use light except in vicinity of Big Bend National Park and Guadalupe Mountain National Monument

High Plains BMCA

- almost entirely private ownership
- extremely little pristine habitat
- fairly densely populated
- large farms growing cotton, sorghum, and wheat
- extensive livestock feeding occurs
- one of the most agriculturally productive areas in the country
- extensive network of roads and railroads
- extensive network of oil, liquid gas, and natural gas pipelines
- high local production of oil and gas
- few land-use plans outside urban areas

South Platte Plains BMCA

- land ownership primarily private
- little pristine or low disturbance habitat
- highest population density of all of the BMCAs
- railroads through area
- farm-to-market highways
- one natural gas pipeline
- land use primarily grazing and raising of livestock and hay
- some production of oats, corn, and sugar beets
- some current recreational usage
- only urban areas have land-use plans

Table 2-1 gives the details of land ownership within the various BMCAs.

Table 2-1. Summary of land status in BMCAs.

BMCA	DEPARTMENT OF INTERIOR		DEPARTMENT OF DEFENSE		PRIVATE LAND		TOTAL	
	PERCENT OF AREA	MI^2 (KM^2)	PERCENT OF AREA	MI^2 (KM^2)	PERCENT OF AREA	MI^2 (KM^2)	PERCENT*	MI^2 (KM^2)
Central Nevada	73	4,600 (11,914)	25	1,575 (4,079)	2	125 (324)	100	6,300 (10,100)
California Mojave	92	5,795 (15,009)	8	505 (1,308)	1	65 (168)	101	6,365 (10,200)
Luke Yuma	73	5,035 (13,040)	10	690 (1,787)	17	1,175 (3,043)	100	6,900 (11,100)
White Sands	84	5,795 (15,009)	12	830 (2,150)	4	275 (712)	100	6,900 (11,100)
West Texas	6	415 (1,075)	0	0 (0)	94	6,485 (16,796)	100	6,900 (11,100)
Texas High Plains	0	0 (0)	0	0 (0)	100	5,300 (13,727)	100	5,300 (8,500)
South Platte	0	0 (0)	0	0 (0)	100	5,300 (13,727)	100	5,300 (8,500)

372T-4009

*May not equal 100 percent due to rounding error.

Source: National Atlas, 1970.

2.4 BASING MODE-SPECIFIC RELATIONSHIPS

The amount of land required for the project varies dramatically by the security system selected and by the spacing selected. A lesser degree of variation occurs for the four basing modes. While the basing mode decision may be made at Milestone II, the tradeoffs of project performance (security and spacing) and environmental impacts will probably be deferred for more complete evaluation during FSED.

As shown on Figure 2-1, the fenced area for full deployment with area security in the vertical shelter mode requires the least amount of land at nominal spacing. Slope-sided pools require about 25 percent more land, hybrid trenches about 33 percent more land, and horizontal shelters about 50 percent more land. With expanded spacing, the hybrid trench would require the least land with vertical shelters requiring about 25 percent more, slope-sided pools about 33 percent more, and horizontal shelters about 70 percent more land. For point security, the fenced area, from which the public and current land uses must be excluded, falls from several thousand square miles to fewer than 50 sq mi.

Comparing the fenced area requirements on Figure 2-1 with the BMCA size data in Table 2-1, it is seen that the BMCAs generally are not sufficiently large to accomodate most alternative projects. The BMCAs are not considered as alternative sites, but as representative of different environmental conditions in geotechnically acceptable areas. The alternative sites considered in the siting and deployment studies that are being performed and will be available over the next few years will focus on different areas than the BMCAs. Some BMCA lands will likely be included but the exact boundaries will shift as FSED more fully defines the project requirements and the environmental impacts of these requirements.

The fenced area on Figure 2-1 is that area the Air Force must control under the various project alternatives. The public and current land uses would be excluded from all fenced areas. To the extent possible, highways, railroads, transmission lines, and other utility corridors would remain in place and available for public and private use. A second area requirement also is shown on Figure 2-1, the deployment area. Examination of

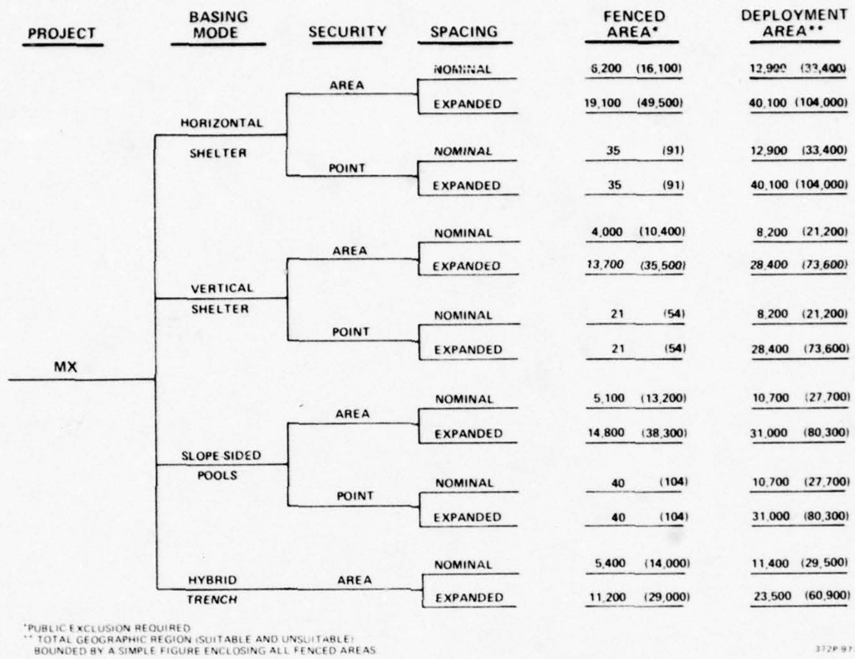
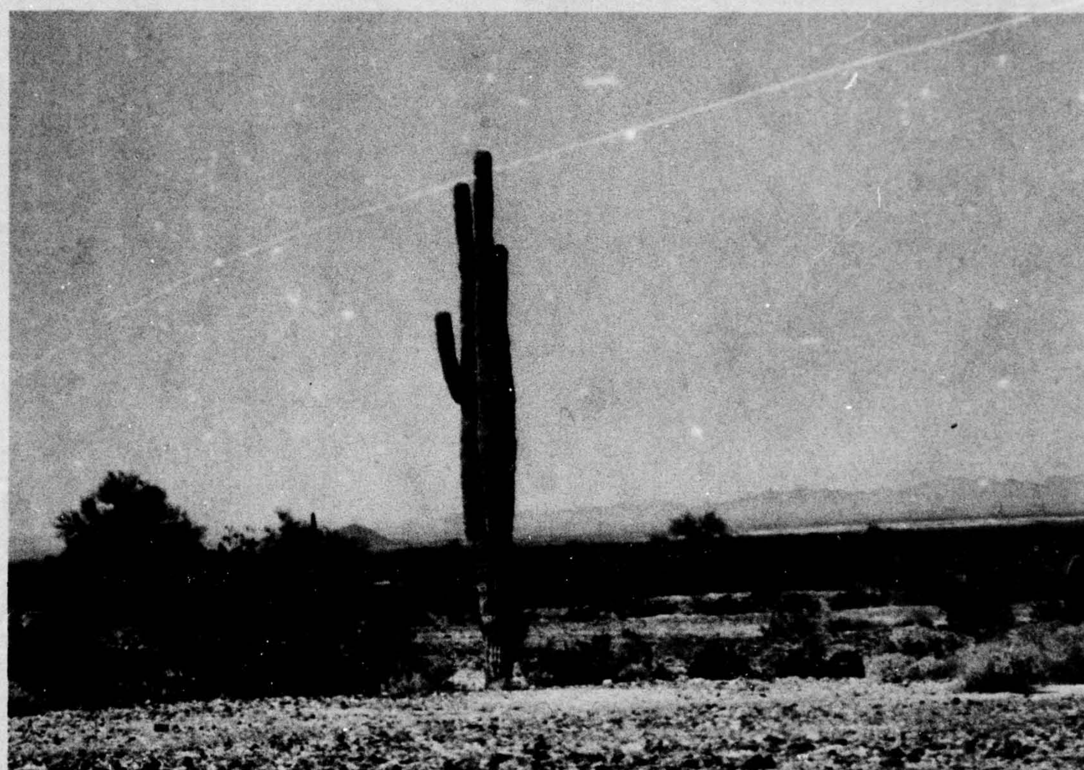


Figure 2-1. Land required for alternative MX basing modes in mi^2 (km^2).

the various BMCA maps shows very irregular shapes. The deployment area is the total geographic region, including geotechnically acceptable and unacceptable land that would be bounded by a simple figure or shape enclosing all fenced areas. The size of this region varies with the basing mode and the spacing between aimpoints, but does not vary with the security mode. The Air Force would not control access to the entire deployment area, only the fenced portion thereof.

The variation of water requirements between modes will also potentially affect land use in any selected deployment area. Trench deployment requires 50 percent more water than shelters and pool deployment would require twelve times the water of shelters. Unless the deployment area had sufficient water available, agriculture in the area could be adversely affected.

Note: It should be noted in all of the above discussion that the availability of water and the allocation of water rights are governed by the general principles and codified provisions of Western water law.



Environmental Impacts

3
KEY ENVIRONMENTAL ISSUES

This section summarizes the results of an in-depth environmental analysis of the various MX basing mode alternatives to provide a basis for comparison of these alternatives from an environmental perspective. The analysis used for this evaluation considers various points of view concerning the MX project expected to be expressed by the public and private sectors, including government agencies, special interest groups, conservationists, and others.

The methodology identifies the basing mode characteristics that impact the environment, determines the environmental features and variables effected, and computes the absolute values of these effects. A computerized impact analysis technique combines these effects with site-specific environmental constraint factors representative of each basing mode comparison area to produce representative relative impact potentials for each environmental variable of interest. Relative impact potentials are derived over the broad range of site-specific constraints for full coverage of the relative impact potentials.

Summary variables corresponding to anticipated concerns are synthesized by combining the relative impact potentials of those environmental variables of interest to each group considered.

3.1 ANALYSIS TECHNIQUE

The environmental analysis used to evaluate the impacts of the various multiple aimpoint systems consists of five major steps. These steps include:

- characterization of the engineering features, parametrically for each of the main basing modes

- determination of the primary engineering factors which are the driving functions for the environmental effects
- identification of basic environmental variables which produce the direct environmental effects
- development of the functional relationships between the primary factors and the anticipated environmental variables
- development of the environmental impact levels associated with each perceived environmental variable
- identification of the set of environmental impacts that is of concern to each specific group, e.g., conservationists and local business interests
- combination of each set of impacts into a summary impact
- display of the values of each summary impact for different basing mode configurations for comparison purposes

The key to this analysis is the treatment of the project configuration in a parametric manner that reflects the range of conceivable system parameters or primary factors, and calculation of associated sensitivities to variations in these factors. The sensitivity functions reflect sensitivity of environmental impact potentials to changes in the project configuration. One can determine both the stability of the results relative to the project configuration and the adaptability of the project to mitigating actions. The environmental model uses systems analysis techniques to produce an overview picture of the relative environmental impact of each of the multiple aimpoint concepts.

All project features, environmental variables, and impacts are determined by defined functional relationships. The input required is a particular project element (e.g., number of aimpoints, spacing of aimpoints, configuration of aimpoints), and the output is an impact potential for a given variable at each BMCA.

Information on significant impacts is developed from the more than 200 engineering, environmental, legal baselines, and expert opinion, reduced to a consistent unit of measure, summarized, and formatted to facilitate comparisons among basing modes. Traceability is maintained from each summarized information item back to the baseline from which it was derived. Results are presented by basing mode configuration, potential site, impact, and interest group.

Project Configuration (3.1.1)

A wide range of project configuration characteristics has been considered. These include:

- Four basing modes
- Area and point security
- Nominal and expanded spacing
- Single and split basing

Each possible combination of the above characteristics has been examined at each basing mode comparison area. Specific values employed in the analysis are given in Table 3-1.

The Primary Factors (3.1.2)

The next stage in the environmental analysis consists of identifying the project characteristics that are at the interface between the engineering properties and the environmental impact of the project. Figure 3-1 shows the relationship between the engineering project

Table 3-1. System parameters and their values for the deployment modes considered.

PARAMETER	VALUE FOR MODE (FULL FORCE CONFIGURATION)							
	HORIZONTAL SHELTER		VERTICAL SHELTER		SLOPE-SIDED POOL		HYBRID TRENCH	
	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED
Area Security								
Missiles	250	250	230	275	205	205	198	250
Aimpoints/Missile	19	19	20	17	26	26	52	49
Aimpoints	4,750	4,750	4,600	4,675	5,330	5,330	10,296	12,250
Spacing ft (m)	5,000 (1,500)	8,800 (2,700)	3,800 (1,200)	7,000 (2,100)	4,300 (1,300)	7,300 (2,200)	2,200[1],3,400[2] (700), (1,000)	2,700[1],4,800[2] (800),(1,600)
Aimpoints Constructed/yr	950	950	920	935	1,066	1,066	2,059	2,450
Point Security								
Missiles	250	250	230	275	205	205	—	—
Aimpoints/Missile	19	19	20	17	26	26	—	—
Aimpoints	4,750	4,750	4,600	4,675	5,330	5,330	—	—
Spacing ft (m)	5,000 (1,500)	8,800 (2,700)	3,800 (1,200)	7,000 (2,100)	4,300 (1,300)	7,300 (2,200)	—	—
Aimpoints Constructed/yr	950	950	920	935	1,066	1,066	—	—

372T-4013

[1]Along trench.

[2]Between trenches.

Note: For 1/3 and 2/3 force configurations—divide Missiles, Aimpoints/Missile, Aimpoints and Aimpoints Constructed/Yr by 3 and 3/2 respectively; spacing remains the same.

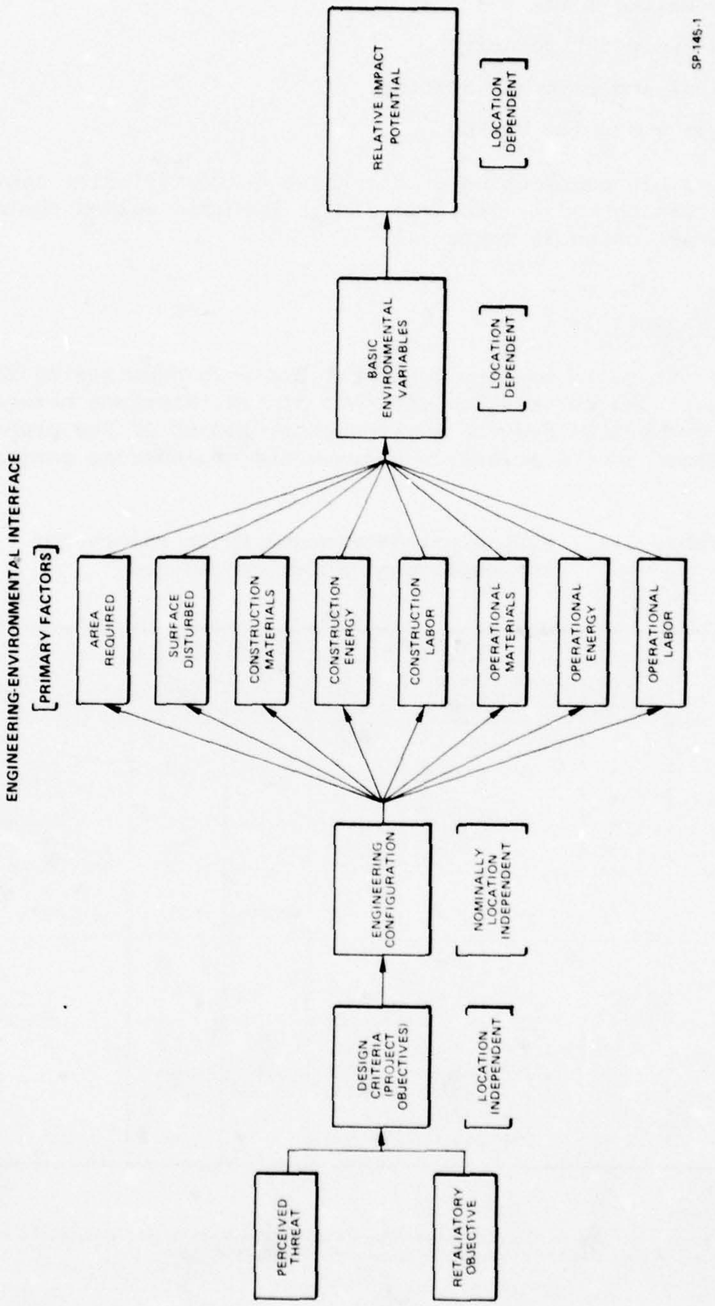


Figure 3-1. Typical primary factors at the engineering/environmental interface and their relationship to the impact analysis process.

configuration and the generic primary factors, which include fenced, safety, and deployment areas, surface disturbed, amounts of materials, energy, and labor utilized during construction. Functional relationships between the system parameters identified in Table 3-1 and the primary factors have been developed and entered into the computerized analysis program for all the deployment mode options discussed in this report. The values of the primary factors at the nominal deployment values (Table 3-1) are shown in Table 3-2.

To illustrate this element of the methodology the following paragraphs describe the development of the functional relationship between land area required as defined in section 1.2.1.3 and the basing mode configuration parameters.

Idealized minimum land requirements or maximum packing density for shelters, results from siting them in an equilateral triangle array, Figure 3-2. Each missile will require

$$\frac{0.866 \times \overline{\text{Spacing}^2}}{5{,}280^2} \times \text{No. of aimpoints/missile} = \text{sq. mi}$$

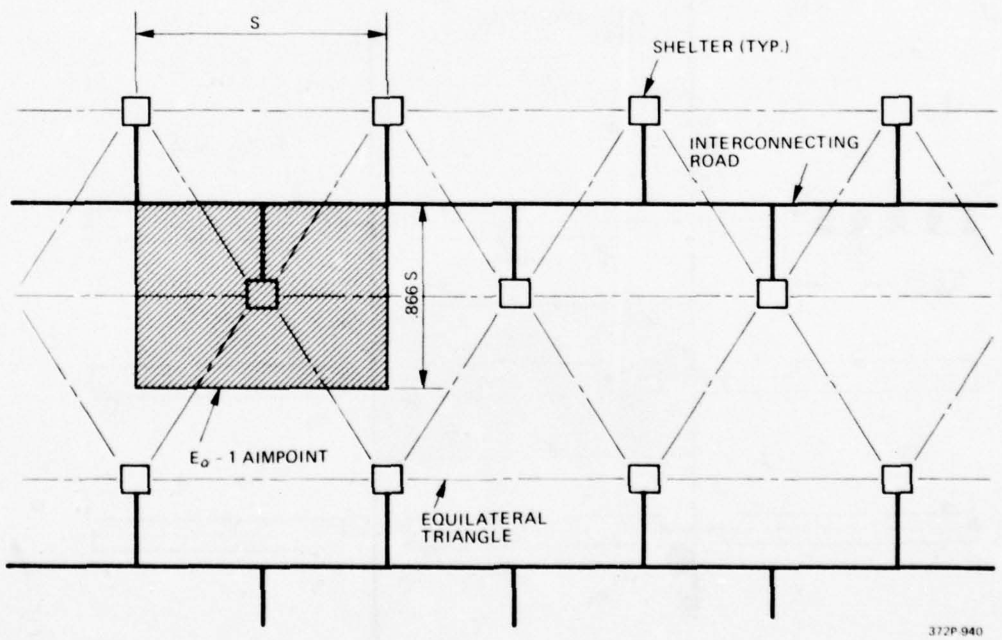


Figure 3-2. Shelter array.

In a similar manner, trenches can be sited for maximum density or minimum area in a rectangular array as shown in Figure 3-3. Each trench containing one missile will require

$$\frac{[(\text{No. of aimpoints/missile} \times \text{distance between aimpoints}) + 500]}{5{,}280^2}$$

$$\times \text{ Distance between trenches} = \text{sq. mi}$$

Actual land required will be greater than these idealized estimates. Need for supporting facilities, avoidance of local terrain features such as streams and gullies, use of existing roads, small fragmented and unusable parcels of suitable area will all require more land than the ideal estimate. Estimates of the actual areas have been developed by use of terrain factors which are the ratio of the actual geographic land areas to the idealized or minimum areas. Terrain factors used in the analysis are given in Table 3-3.

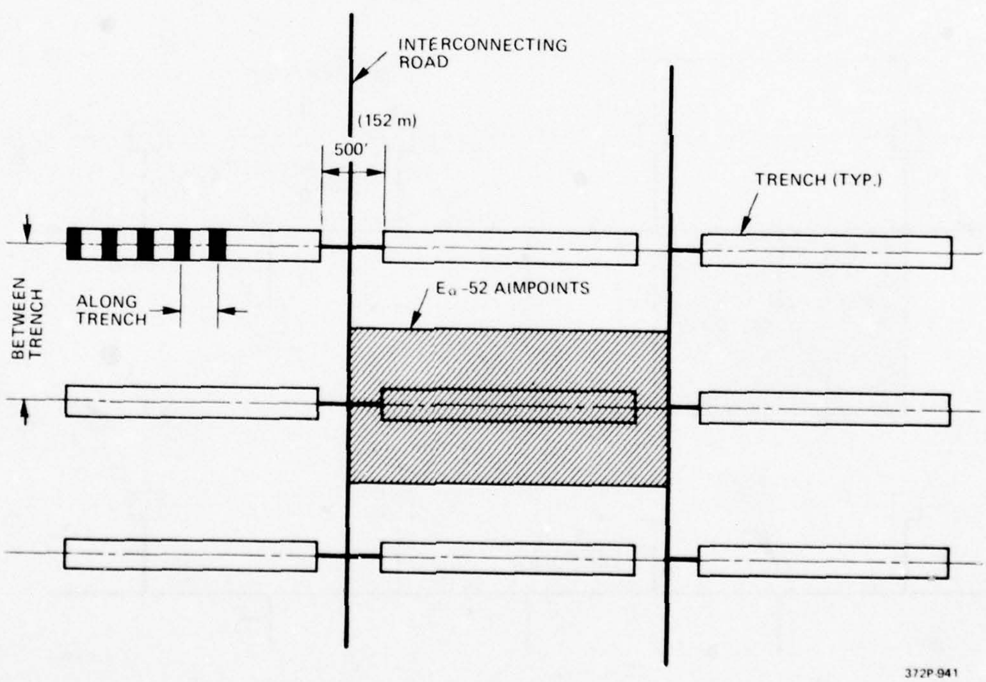


Figure 3-3. Trench array.

Table 3-2. Values of primary factors for configura

PRIMARY FACTORS*		AREA SECURITY						
		HORIZONTAL SHELTER		VERTICAL SHELTER		SLOPE-SIDED POOL		INLINE HYBRI
		NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL
Fenced Area	(sq. mi)	6,200	19,000	4,000	14,000	5,000	15,000	5,400
	(km^2)	16,000	50,000	10,000	35,000	13,000	38,000	14,000
Deployment Area	(sq. mi)	13,000	40,000	8,200	28,000	11,000	31,000	11,000
	(km^2)	34,000	100,000	16,000	74,000	28,000	80,000	30,000
Safety Area	(sq. mi) (km^2)	0	0	0	0	0	0	0
Surface Area Disturbed	(sq. mi)	190	240	120	180	240	290	290
	(km^2)	480	630	310	460	620	760	740
Total Earth Handled	(10^6 yd^3)	430	540	190	280	330	480	900
	(10^6 m^3)	330	410	140	220	250	370	690
Cement	(10^6 tons/yr)	0.14	0.14	0.13	0.13	0.17	0.17	1.51
	(10^6 metric tons/yr)	0.13	0.13	0.12	0.12	0.16	0.16	1.37
Fly Ash	(10^3 tons)	74	74	78	79	84	84	850
	(10^3 metric tons)	67	67	71	72	76	76	770
Reinforcing Steel	(10^3 tons)	160	160	150	150	86	86	593
	(10^3 metric tons)	140	140	130	140	78	78	540
Sand	(10^7 tons)	3.3	4.8	2.2	3.4	5.6	7.9	16
	(10^7 metric tons)	3.0	4.4	2.0	3.1	5.1	7.2	14
Aggregate	(10^7 tons)	4.3	6.4	3.1	4.7	5.9	9.8	3.0
	(10^7 metric tons)	3.9	5.8	2.8	4.3	5.3	8.9	2.8
Water	(10^3 acre-ft)	9.7	11.0	7.0	7.8	45	46	24
Construction	(10^6 m^3)	12.0	13.0	8.6	9.6	55.0	57.0	29.0
Water-Construction	(10^3 acre-ft)	28.0	46	23	39	340	360	36
+ 10 yr operation	(10^6 m^3)	34	57	28	48	420	450	44.0
Liquid Asphalt	(10[illegible] gallons)	0.14	0.21	0.13	0.20	0.20	0.29	0.13
	(10^6 m^3)	0.51	0.79	0.49	0.78	0.77	0.11	0.50
Electricity-Construction (MW)		180	180	180	180	200	200	250
Electricity-Operation (MW)		100	130	96	120	110	140	190
Petroleum Fuels	(10^7 gal/yr)	2.3	2.8	7.5	2.1	5.0	5.5	14.0
	(10^4 m^3/yr)	8.6	11.0	28	7.9	19.0	21.0	54.0
Vehicle Miles	(10^6 mi/yr)	9.7	14.0	6.5	9.7	18.0	24.0	18.0
	(10^6 km/yr)	16.0	23.0	10	16.0	29.0	39.0	29.0
Labor-Construction (10^3)		10.7	12.0	8.5	9.7	13	14	17
Labor-Operation (10^3)		5.0	10.1	4.4	8.9	5.7	12	4.2
Cost-Construction (10^9 \$)		2.7	3.3	2.7	3.2	4.8	5.5	4.2
Disturbed Area	(sq. mi)	56	83	43	73	76	100	2
Operation	(km^2)	150	220	110	190	200	270	5

*Estimated values based on present conceptual configurations. Subject to refinement during FSED, and further analysis in subsequent environmental statements.

f primary factors for configurations listed in Table 3-1.

RITY				POINT SECURITY					
SLOPE-SIDED POOL		INLINE HYBRID TRENCH		HORIZONTAL SHELTER		VERTICAL SHELTER		SLOPE-SIDED POOL	
OMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED
,000 ,000	15,000 38,000	5,400 14,000	11,000 29,000	35 92	35 92	21 54	21 55	40 100	40 100
,000 ,000	31,000 80,000	11,000 30,000	24,000 61,000	13,000 34,000	40,000 104,000	8,200 21,000	28,000 74,000	11,000 28,000	31,000 80,000
0	0	0	0	4,800 12,000	4,800 12,000	4,600 12,000	4,700 12,000	5,300 14,000	5,300 14,000
240 620	290 760	290 740	400 1,000	190 480	240 630	110 290	160 420	240 620	300 770
330 250	480 370	900 690	1,200 910	430 330	540 410	130 100	210 160	330 250	480 370
0.17 0.16	0.17 0.16	1.51 1.37	1.99 1.81	0.14 0.13	0.14 0.13	0.13 0.12	0.13 0.12	0.17 0.16	0.17 0.16
84 76	84 76	850 770	1,000 900	74 67	74 67	72 66	73 66	84 76	84 76
86 78	86 78	593 540	700 630	160 140	160 140	150 130	150 140	86 78	86 78
5.6 5.1	7.9 7.2	16 14	19 17	3.2 2.9	4.8 4.4	1.7 1.6	2.7 2.5	5.6 5.1	7.9 7.2
5.9 5.3	9.8 8.9	3.0 2.8	3.6 3.3	4.3 3.9	6.5 5.8	2.2 2.0	3.4 3.1	5.9 5.3	9.8 8.9
45 55.0	46 57.0	24 29.0	34.0 42.0	9.7 12.0	11 13.0	9.7 12.0	11 13.0	45 55.0	46 57.0
340 420	360 450	36 44.0	47 58.0	32 30	55 68.0	29 36.0	50 62.0	350 430	370 460
0.20 0.77	0.29 0.11	0.13 0.50	0.14 0.54	0.14 0.51	0.21 0.79	0.9 3.7	0.16 0.62	0.2 0.77	0.3 1.1
200	200	250	300	180	180	180	180	200	200
110	140	190	220	110	140	10	130	120	160
5.0 19.0	5.5 21.0	14.0 54.0	16.0 60.0	2.3 8.7	2.8 11.0	1.6 6.0	1.9 7.4	5.1 19.0	5.5 21.0
18.0 29.0	24.0 39.0	18.0 29.0	20.0 33.0	9.8 16.0	14.0 23.0	6.8 11.0	9.4 15.0	18.0 29.0	24.0 39.0
13	14	17	24	11	12	8.5	9.7	13	14
5.7	12	4.2	5.6	6.4	13	5.6	11	7.3	15
4.8	5.5	4.2	5.0	2.7	3.3	2.5	2.0	4.8	5.5
76 200	100 270	2 5	3 8	72 190	97 250	83 220	130 350	89 230	120 310

FSED, and further analysis

2

Table 3-3. Terrain factors.

AREA			MEAN TERRAIN FACTOR
SUITABILITY DIMENSION	LAND USE DIMENSION		
	Deployment Region	Trench	4.2
		Vertical Shelter	4.0
		Other	3.5
Coarse Screened Area			3.3
Intermediate Screened			2.22
	Fenced Area	Trench*	2.00
		Vertical Shelter*	1.9
		Other*	1.67
Fine Screened Area			1.25
	Idealized Area		1.00

*Area security only.

The ratio of idealized area to the various fenced areas was developed from sample layouts of trenches and shelters. It should be noted that area security fences will enclose some area eliminated by the screening criteria, e.g., small pockets of unsuitable area and projections of unsuitable area into the parcel that must be purchased.

Factors differ by basing mode since the depth of the vertical shelter eliminates some local area by reason of depth to water or hard rock and the trench requires more level land than shelters. Furthermore, the trench requires approximately 20 mi (32 km) lengths of minimum curvature and hence lacks siting flexibility, thus requiring more land.

Each specific potential siting region has different characteristics and will have different terrain factors. See section 1.1 for terrain factors applying to Northern Basing of Minuteman III. However, to develop those specific layouts would be required in each BMCA for each configuration considered. It is estimated that the above mean terrain factors have a coefficient of variation (standard deviation divided by the mean) of about 25 percent.

<u>The Basic Environmental Variables</u> (3.1.3)

<u>Identification</u> (3.1.3.1). The next stage in the analysis consists of identifying the environmental characteristics affected by the project

that are likely to result in environmental impacts. The method for determining the environmental variables to be examined is shown in Figure 3-4. It consists first of obtaining the appropriate engineering and design criteria for each of the basing modes being considered and determining those features of the project that could cause environmental effects. Second, it depends on identifying site constraints associated with each BMCA and then examining for each area the environmental sensitivity to the project actions. The most sensitive variables with respect to (1) project actions that could cause environmental effects, and (2) environmental features susceptible to those effects are then chosen for further examination. As a final screening, the variables are examined with respect to the perspectives of the various groups potentially interested in the impacts of the project.

Figure 3-5 lists the basic environmental variables selected for detailed analysis in this study.

Relative Impact Potential (3.1.3.2). The final stage in the environmental analysis is determining the relative impact potential of the effect at each BMCA. Functional relationships have been developed relating the magnitude of the change to the basic environmental variables at each BMCA and the relative impact potential associated with that change. The relative impact potentials are functions of a number of perceptual factors.

The Parametric Impact Analysis Nomogram (3.1.4)

Summary analysis tools used in this environmental study are the parametric impact analysis nomograms prepared for each of the basic environmental variables for each basing mode and security configuration. An example of a nomogram is shown in Figure 3-6 for the environmental variable "Displaced Population." Each nomogram consists of a series of four plots. The first is the relationship between a basic design feature (in the case of the example shown, the total number of aimpoints) and a primary environmental factor (in this case, disturbed area).

The second plot (upper right) is used to display the functional relationship between the primary factor as the independent variable, and the appropriate basic environmental variable (from Figure 3-5) as the dependent variable. Different functional relationships frequently apply to different sites, so each of the BMCAs is analyzed independently. Linear functions are used in many cases where the complexities of the functional relationship are not known.

The third plot (lower right) shows the relationship between the environmental effect and the relative impact potential specific to the BMCA in which it occurs. The relative impact potential curves are scaled

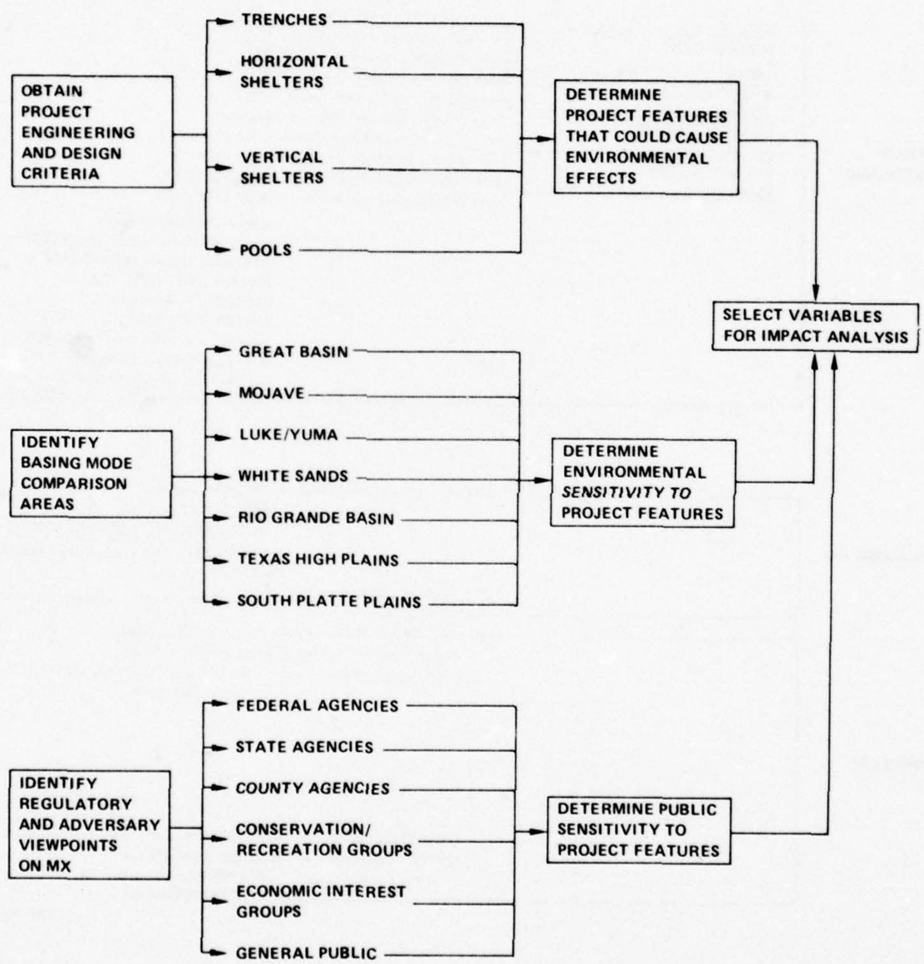


Figure 3-4. The steps involved in selecting the basic environmental variable for impact analysis.

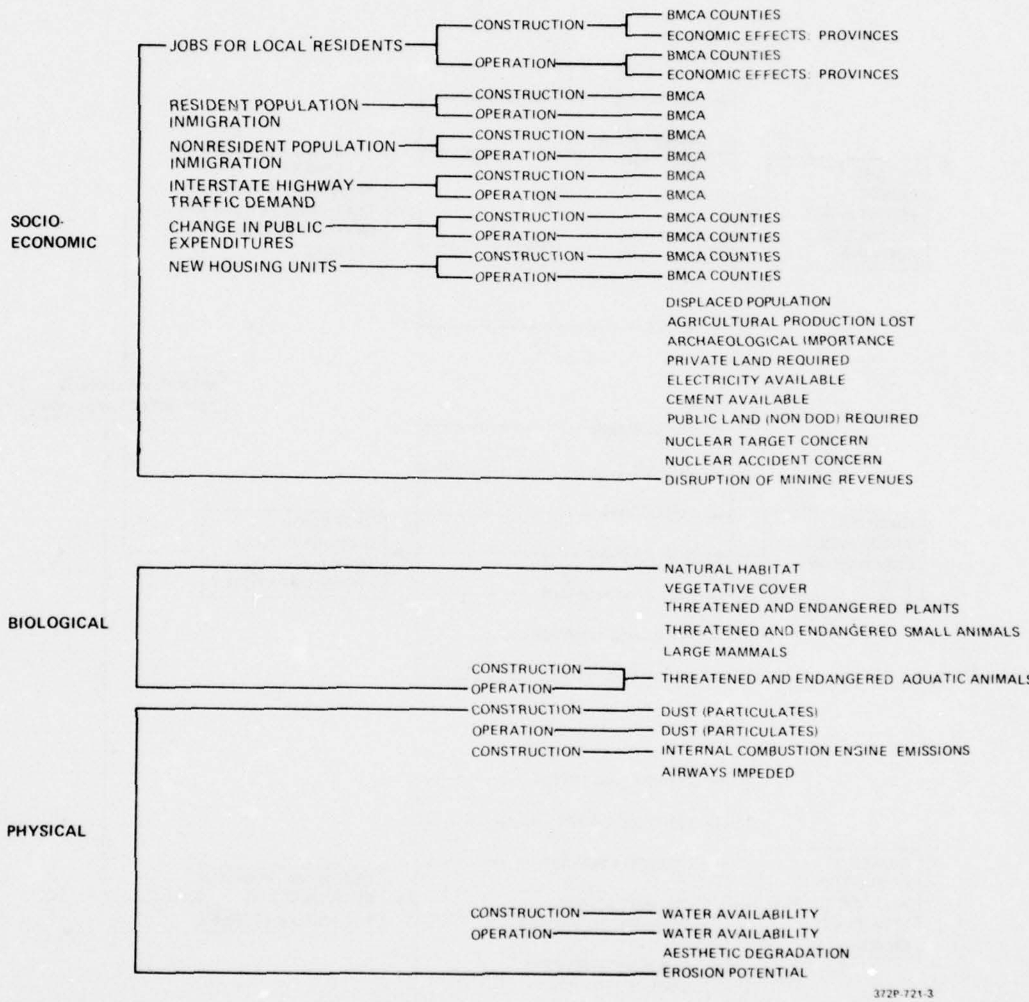
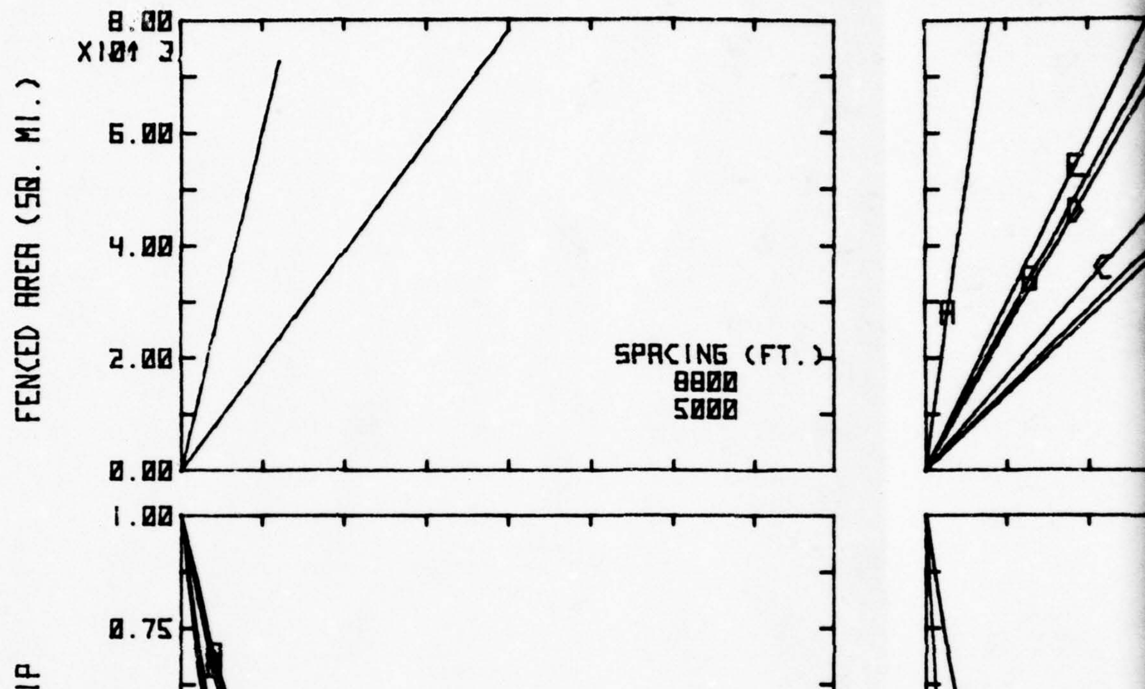


Figure 3-5. Sample environmental variables considered in this report.

PARAMETRIC IMPACT ANALY

DISPLACED POPULATION (10

HORIZONTAL SHELTER - AREA 5



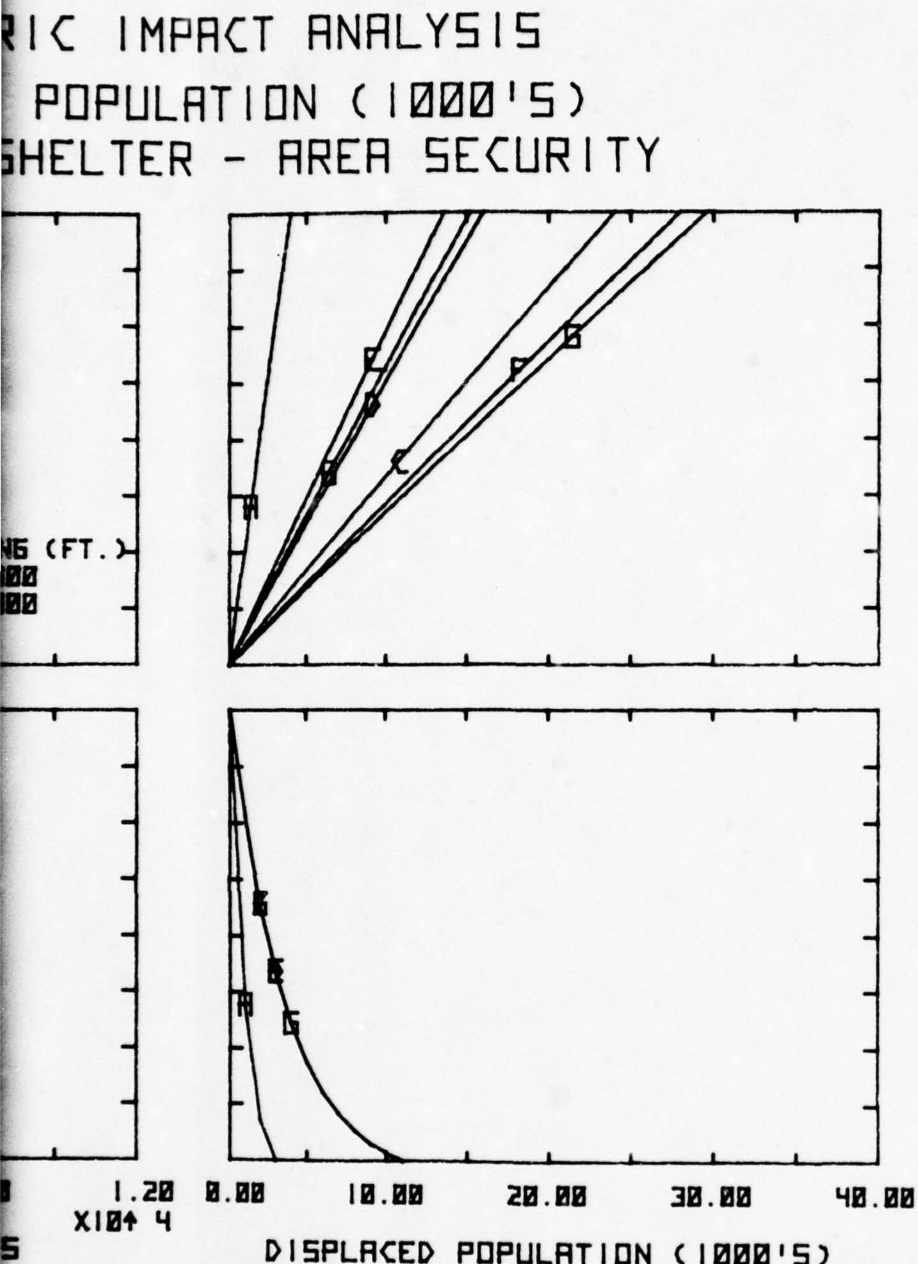

RIC IMPACT ANALYSIS
POPULATION (1000'S)
SHELTER - AREA SECURITY
NG (FT.)
1.20
X10↑ 4
0.00
10.00
20.00
30.00
40.00
DISPLACED POPULATION (1000'S)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure 3-6

2

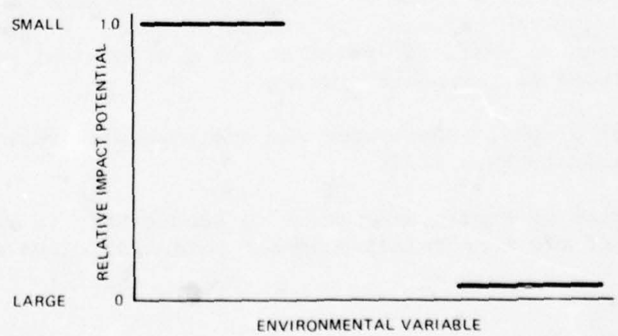
from 0 to 1. A value of 1.0 implies that the relative impact potential is small, and a value of 0 means that the relative impact potential is large. A value between 0.7 and 0.4 indicates moderate impact potential while a value between 0.4 and 0.05 indicates a moderate to large relative impact potential.

The fourth plot (lower left) shows the relationship between the relative environmental impact and the basic design feature of interest that determines the impact value thus giving the system designer a means of seeing how configuration changes affect the potential impact of the system. The information in this box is used to generate the impact Bar Charts described in section 3.1.5.

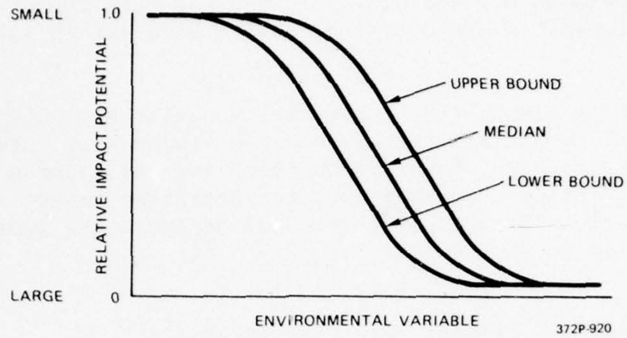
Uncertainty Displayed by Impact "Bar Charts" (3.1.5)

Figure 3-6 presents what appear to be deterministic relationships with no data uncertainties throughout the process. This is not the complete picture, and the relationship lines in the upper right, lower right, and lower left plots of Figure 3-6 are only the mean values. To avoid cluttering the nomograms beyond usability, uncertainties are not displayed. However, uncertainties are calculated and retained throughout the process. If the complete details for one BMCA only were retained on the nomogram, it would appear as in Figure 3-7. The upper left box is as before. The upper right-hand box shows the relationship between the engineering factors and environmental effect for a given BMCA. Here, the scientist enters his estimate of the effect value related to the engineering factor based on the statistical uncertainty in the baseline data. The information and rationale used to arrive at this relationship constitutes the environmental baseline. The lower right-hand box shows the relationship between the environmental effect and the relative impact potential, ranging from 1.0 for clearly small potentials to 0 for large ones.

Intermediate relative impact potentials are assigned where appropriate. However, they introduce another source of uncertainty—lack of definite knowledge—which has been treated as follows: first, the range of environmental effects where the relative impact potential is small or large is established and plotted as:



Then, the uncertain relative impact potential is shown as indeterminate by a median with an upper and lower bound.



The bounds would usually be spaced about equally above and below the median curve.

The scientist specifies the relationship between the effect and relative impact potential using legal requirements (e.g., air quality standards), professional opinion of concerns of those institutions, agencies and groups interested in the impact, and his best judgment. He records his rationale for this specification. The collection of these rationales form the judgmental baseline.

Finally, the lower left-hand box shows the relationship between the value of the system configuration parameter and the relative impact potential. The lines projected from the upper left box through to the lower left box show the generation of the relative impact potential bars. These bars essentially present a data point with its associated uncertainty for a given set of system parameters. Bars of a selected variable for different configurations can thus be used to compare one configuration with another on an environmental basis.

A full set of impact bars for Displaced Population for all modes and BMCAs for point and area security and nominal and expanded spacing at a full force is given by Figure 3-8. Equivalent sets are available for 1/3 and 2/3 force. Examination of this figure indicates that the potential for displacing population is large for nominal spacing area security and increases when the spacing expands. On the other hand, the potential for displacing population is small for point security at nominal spacing and thus does not increase for expanded spacing.

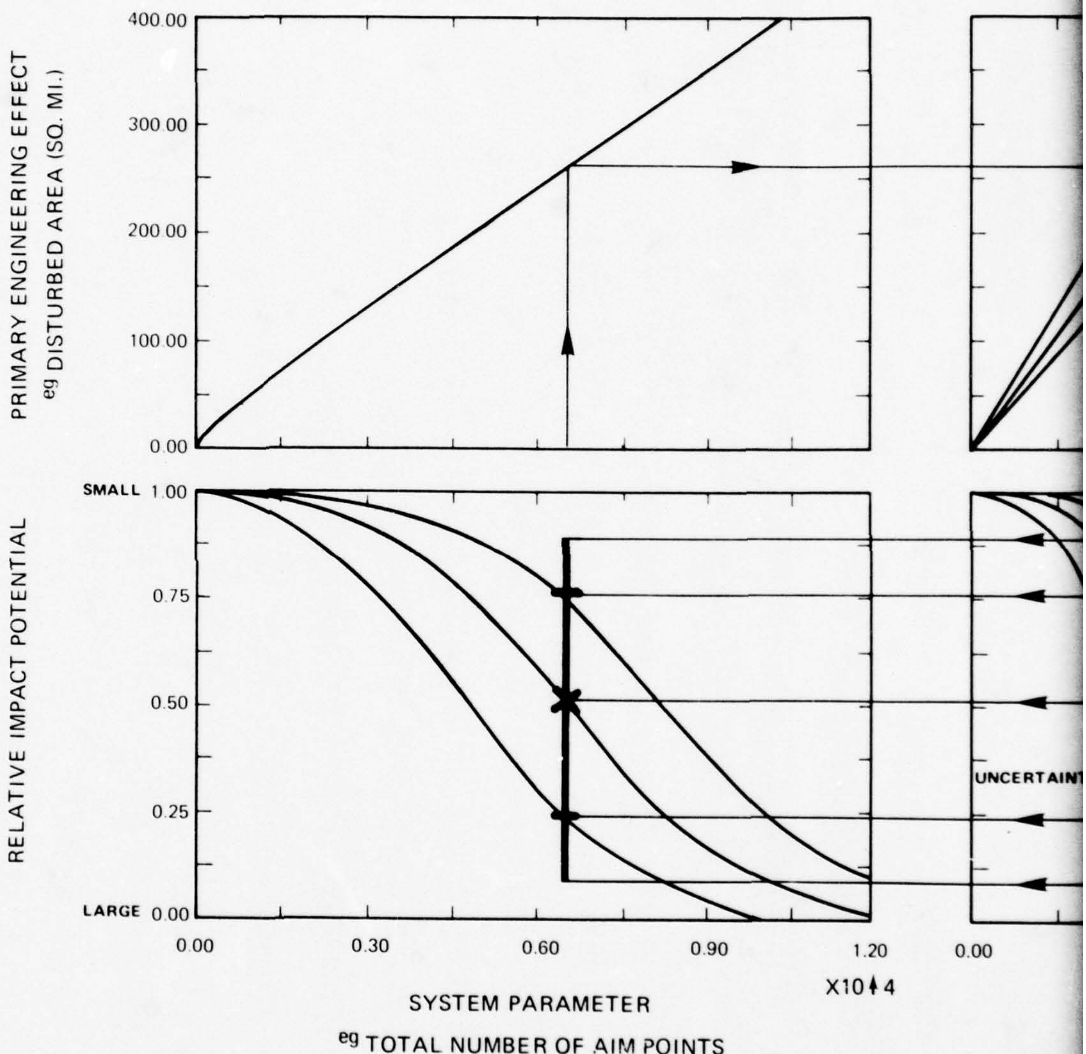
A complete set of these charts for all environmental variables is given in the Appendix to this FEIS.

Along the bottom of Figure 3-8, relative sensitivity is also shown. This is the slope of the mean relative impact potential curve at the

GENERATION OF RELATIVE IMPACT PO

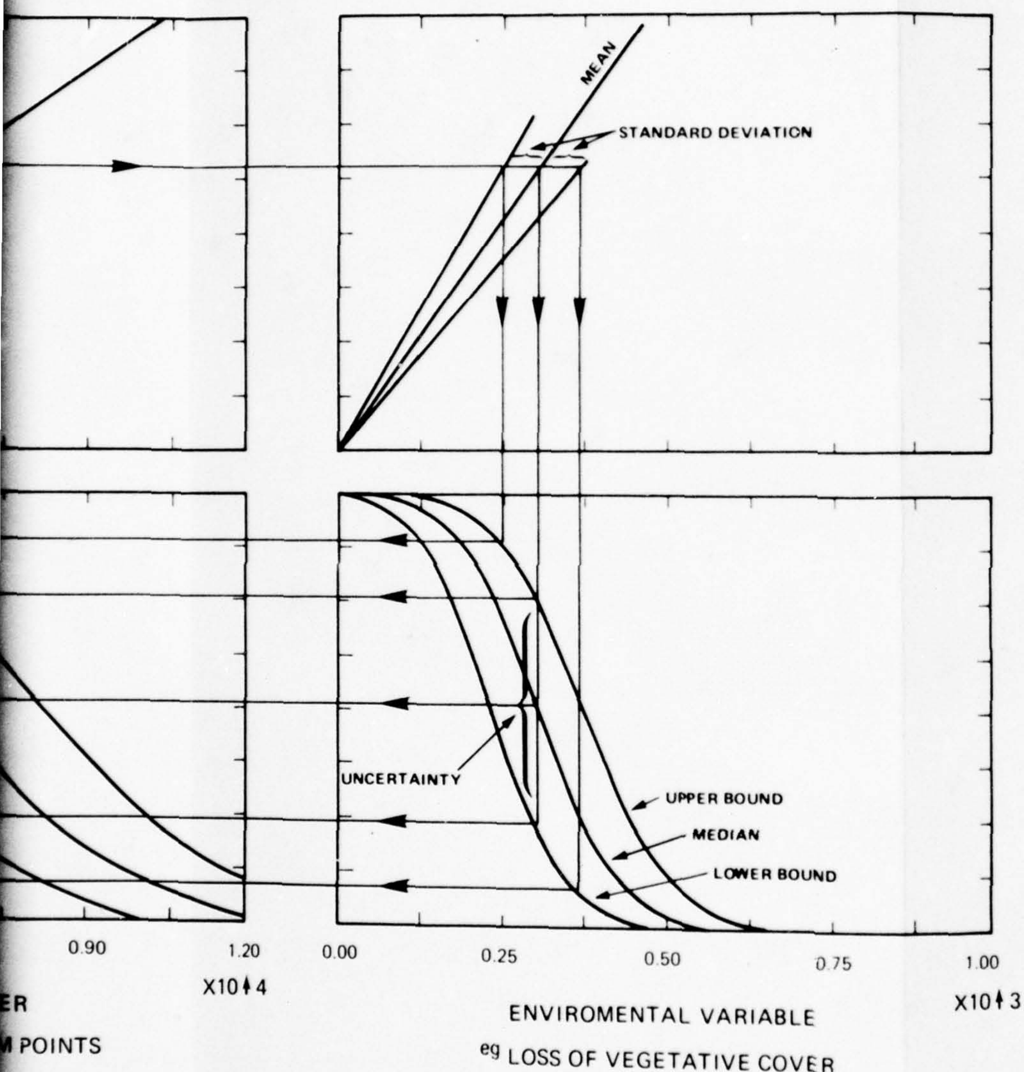
For a given Basing Mode and Compariso

PLOT FROM ENGINEERING BASELINE INFORMATION



GENERATION OF RELATIVE IMPACT POTENTIAL

For a given Basing Mode and Comparison Area



PLOT FROM ENVIRONMENTAL BASELINE INFORMATION

PLOT FROM EXPERT OPINION

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Figure 3-7.

2

nominal project size where the relative impact potential bar is determined. It indicates the relative change in relative impact potential which can be achieved by varying the project parameter.

Impact Aggregations (3.1.6)

The impacts resulting from changes in the basic environmental variables have been aggregated into sets, each set reflecting the perspective of a different interest group. The value of these aggregations is that they aid in identifying the combinations of specific impacts which represent the concerns of the various interest groups. The 13 sets of aggregations of basic environmental variables are listed in Table 3-4. The relative impact potentials of the various environmental variables within a set are combined into an overall relative impact potential for the set by the following formula:

$$\bar{\mu} = \frac{n}{\sum_{r=1}^{n} (\mu_r)^{-1}}$$

where μ_r is the relative impact potential of the r^{th} basic environmental variable. This formula is intentionally conservative in that a low value of any μ_r induces a low value of "$\bar{\mu}$". This facilitates identification of potential problems which might require mitigative measures.

According to the aggregations in Table 3-4, several basic environmental variable "bar charts" such as Figure 3-6 are combined to produce "Anticipated Concerns." An example is shown in Figure 3-9 "Land Rights" (anticipated concern No. 6), which is a combination of Figure 3-8, Displaced Population, with private land required.

A complete set of Bar Charts for each anticipated concern for all basing mode combinations of interest is given in an appendix of this volume.

Table 3-4. Impact aggregation(s).

ANTICIPATED CONCERN	BASIC ENVIRONMENTAL VARIABLES USED AS INDICES OF THE CONCERN
1. Interference—Important Species Potential interference with important biological species: concern for interference with individual species is formally the province of conservation agencies, Fish and Wildlife (game) management agencies, and public land management agencies. Their major constituencies include sportsmen, conservation-minded citizens, and professional and amateur biologists. Endangered species are of importance because their loss can be permanent and can indicate ecosystem disruption. Nonendangered vertebrates are important in allowing nonconsumptive recreational observation.	• threat to protected plants • threat to protected small terrestrial animals and birds • exclusion of large mammals by fencing or human presence • threat to protected aquatic species
2. Air Quality Potential degradation of air quality: air quality is principally under the protection of U.S. Environmental Protection Agency and state health and air quality boards. Decreases of air quality are of interest primarily because of their adverse health effects, and because decreased visual range is generally regarded an aesthetic degradation.	• dust (particulate) concentration during construction • dust (particulate) concentration during operation • nitrogen oxide concentration during construction • sulfur dioxide concentration during construction • reactive hydrocarbon concentration during construction • carbon monoxide concentrations during construction • potential for erosion

Table 3-4. Impact aggregation(s) (cont.).

ANTICIPATED CONCERN	BASIC ENVIRONMENTAL VARIABLES USED AS INDICES OF THE CONCERN
3. Water Quality and Supply Potential decrease in availability and quality of water: water quality is regulated principally by the USEPA. The major water quality concern in the project is degradation of domestic and agricultural supplies, increased sedimentation, and loss of biota. Availability of water is monitored by federal agencies such as the Army Corps of Engineers and the Bureau of Reclamation, as well as the Bureau of Land Management. Multistate, state, county, and municipal water agencies also regulate use. The major supply concern involved in this project is the impact on producing agricultural wells and biologically important springs.	• net water physically available/water required for construction plus 10 years of operation • potential for erosion (sedimentation)
4. Recreation (Access Loss) Restriction of access and recreation: land management agencies favoring multiple use (USFS, BLM) and those specifically supporting recreation (National Park Service and Bureau of Outdoor Recreation) as well as their state and county counterparts to manage recreational activities. The public, privately organized outdoor recreational groups as well as businesses serving these groups all have interests. The variables considered include restriction of access at offsite areas by highway congestion, and exclusion from public lands at the site.	• highway congestion during construction • highway congestion during operation • public lands required not currently under Department of Defense withdrawal

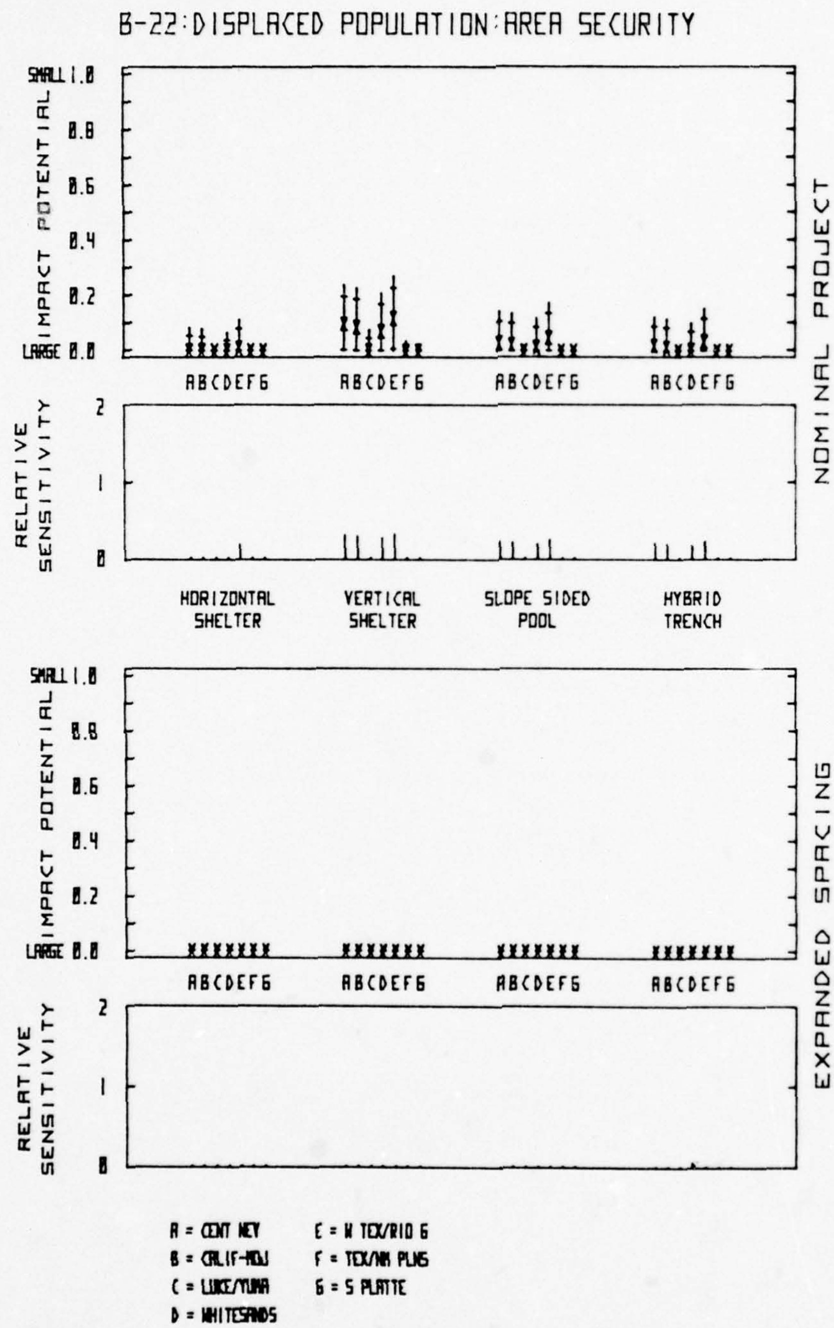
Table 3-4. Impact aggregation(s) (cont.).

ANTICIPATED CONCERN	BASIC ENVIRONMENTAL VARIABLES USED AS INDICES OF THE CONCERN
5. Use of Natural Resources Loss of natural value, natural resources, and possible disruption of ecosystems: conservation interest, including public land management agencies, conservation oriented private groups, and outdoor recreation groups will consider these variables important. They reflect the degree to which the natural character of the land will be degraded by the project.	• aesthetic degradation • loss of natural habitat • loss of vegetative cover • dust (particulate) concentrations during construction • dust (particulate) concentrations during operation • net water physically available/ water required for construction plus 10 years of operation
6. Land Rights Potential displacement of existing inhabitants; exclusion of future inhabitants: this perceptual aggregation supplies an index of total value of potential sites for inhabitation.	• inhabitants displaced • private land required
7. Economics Potential economic changes: this aggregation is intended to summarize the important economic changes that could occur as a result of deployment. It includes three classes of impact: a change in the number of jobs both locally and regionally; a change in the tax monies expended to support community services and the loss of revenue from the major remunerative activities currently occupying the lands in direction. Land owners, business people, and all other local and regional inhabitants will be affected by and interested in the ways these changes affect their financial status.	• jobs for local residents—construction (BMCA) • jobs for local residents—construction (EEP) • jobs for local residents—operation (BMCA) • jobs for local residents—operation (EEP) • change in public expenditures—construction • change in public expenditures—operation • agriculture production lost • mining revenues lost

Table 3-4. Impact aggregation(s) (cont.).

ANTICIPATED CONCERN	BASIC ENVIRONMENTAL VARIABLES USED AS INDICES OF THE CONCERN
8. Local Government Issues Potential change in social infrastructure is intened to summarize those factors responsible for supporting and changing the character and services of a community. The in-migrations are proportioned between people moving in to take up residence (and thereby acquiring a stake in the community) and people coming in as transient workers (traditionally with little regard for community well-being). The change in public expenditures is included here as well as in 7 because this change will largely be channeled into services and included as a part of the community.	• resident population in-migration-construction (BMCA) • resident population in-migration-operation (BMCA) • nonresident population in-migration-construction (BMCA) • nonresident population in-migration-operation (BMCA) • change in public expenditures—construction • change in public expenditures—operation • new housing units—construction • new housing units—operation
9. Public Safety Local concern for public safety: this aggregation combines concern for the dangers of the presence of nuclear materials nearby and the possibility of nuclear accidents.	• nuclear target concern • nuclear accident concern
10. Airways Impeded	• airways impeded (altitude restriction)
11. Archaeology	• archaeological effect—possible disruption of sites
12. Cement	• cement required
13. Electricity	• electric energy required

PARAMETRIC IMPACT ANALYSIS



PARAMETRIC IMPACT ANALYSIS

B-22: DISPLACED POPULATION : POINT SECURITY

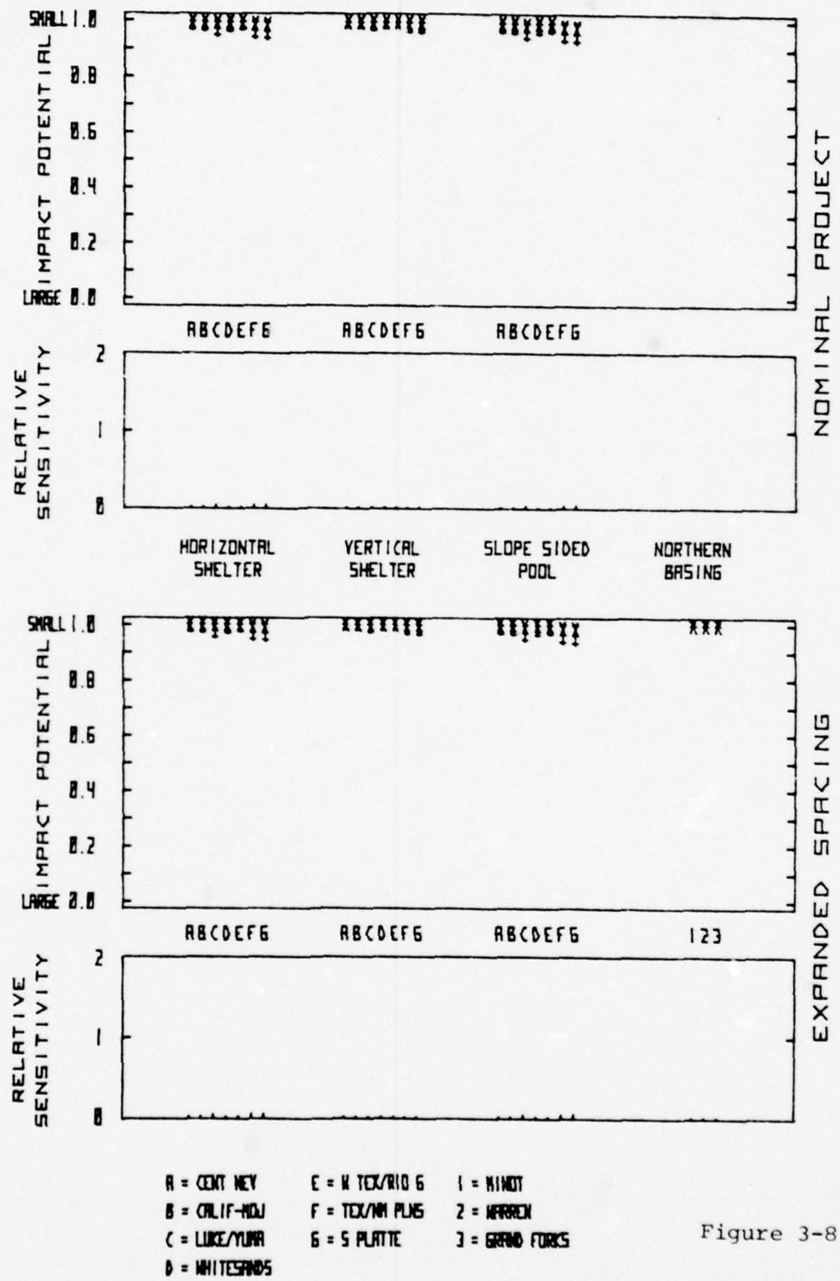
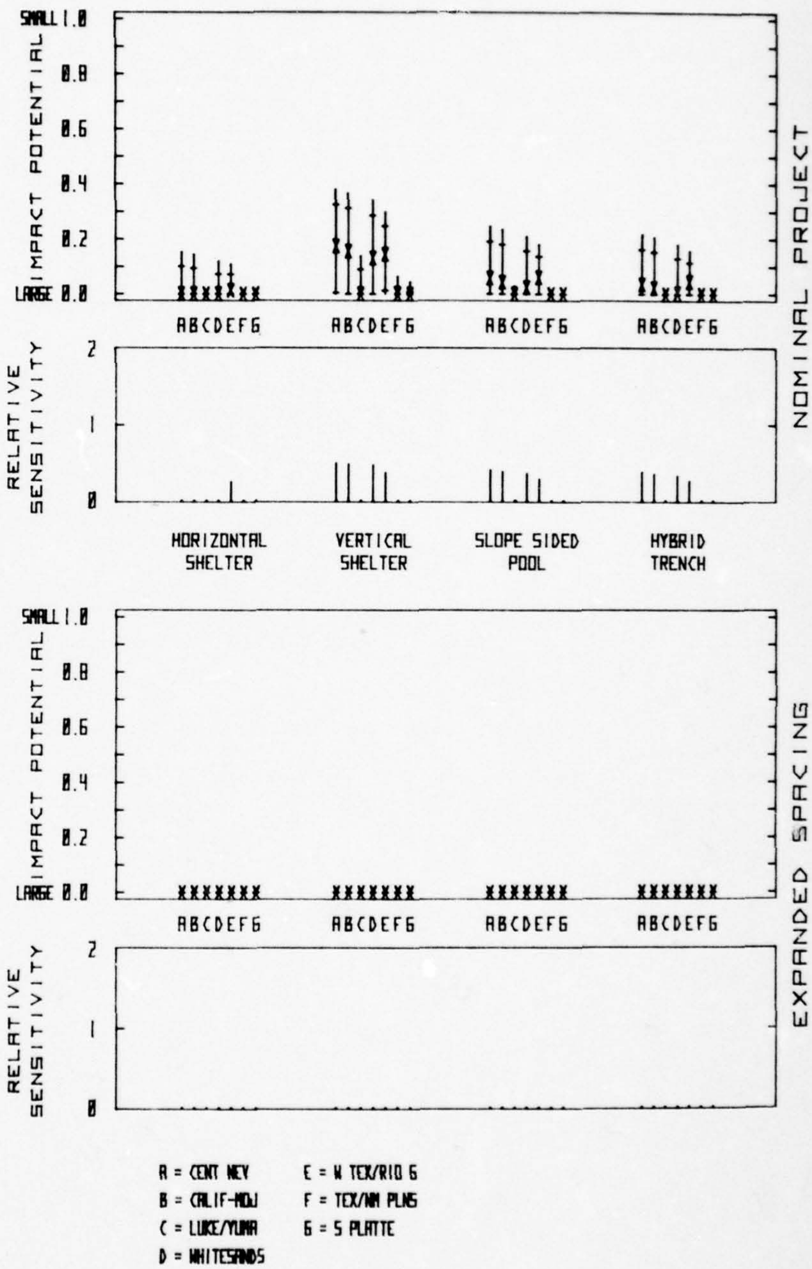


Figure 3-8

2

PARAMETRIC IMPACT ANALYSIS

LAND RIGHTS ISSUES - AREA SECURITY



PARAMETRIC IMPACT ANALYSIS

LAND RIGHTS ISSUES - POINT SECURITY

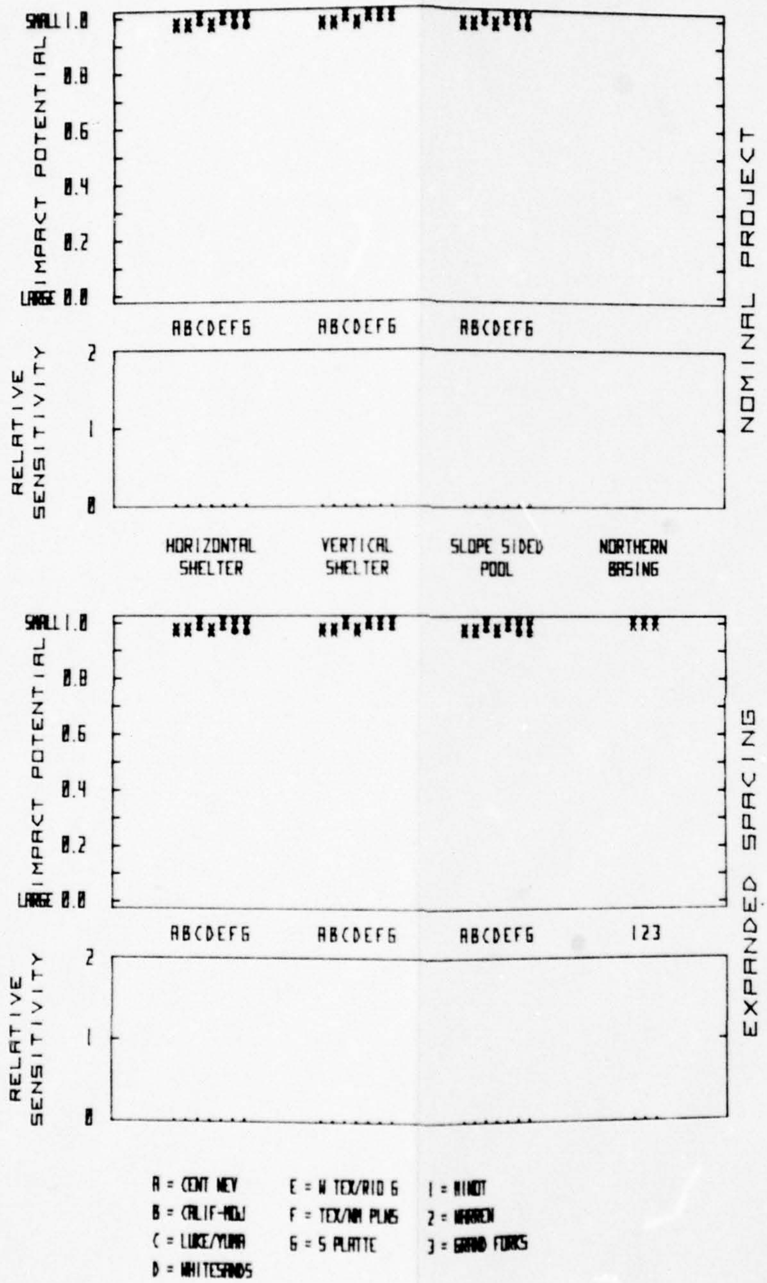


Figure 3-9

3.2 RESULTS OF ENVIRONMENTAL ANALYSIS

Project Configurations Selected for Analysis (3.2.1)

As described in Section 1.1, there are three ways being considered for varying the basing mode configurations away from the nominal project. The security configuration can be either area security or point security. The spacing between aimpoints can have either the nominal values or the expanded values. Also, the project can be split up into portions of two-thirds and one-third and be deployed in more than one location. The values of the definitive parameters can be found in Table 3-1.

Available Environmental Analysis Results (3.2.2)

All these configuration variations have been analyzed for the four basing mode candidates giving a total of 42 mode-configuration combinations. In addition an analysis (reported in Section 4) has been completed for MAP basing of MM III missiles at present Minuteman bases.

The basic information is confirmed in a complete set of nomograms. These nomograms contain estimated absolute values of the environmental effects. Since these nomograms are general and not specific as to number of aimpoints, spacing and do not show uncertainty in the results, they have been summarized into the set of bar charts for each of the forty environmental variables given in the Appendix Volume. These do not represent all of the information in the nomograms as they are selected values corresponding to the configuration parameters under consideration. If other configurations e.g., different numbers of aimpoint were selected additional sets of environmental variable bar charts could be generated.

It will be noted that many of these variables show considerable uncertainty. This is to be expected at this early stage of the analysis when many configurations and prospective site locations are under consideration. Smaller uncertainties are usually associated with large or small potential impacts. This does not necessarily mean that the absolute value is certain simply that it is in a range where the analyst is fairly sure the relative impact will be small or large.

Forty variables are a large number to consider in making comparisons so they have been summarized to the thirteen summary variables or concerns as described in section 3.1. Impact Bar Charts for these are given in the appendix to this Volume. Comparisons among basing modes, security systems, spacing, and split basing can be made by a study of these charts.

Use of Environmental Analysis Results in Selecting Final Design Configurations (3.2.3)

This environmental analysis provides a means of considering and minimizing potential environmental impacts in selecting the final design configuration. Both relative and absolute values of the impacts can be considered.

To illustrate, Figure 3-10 shows the estimated displaced population if the full force were sited in Central Nevada as a function of spacing for all basing modes and point and area security. It is clear that displaced population varies strongly with security mode and spacing. The associated variable Private Land required has similar characteristics as seen in Figure 3-11.

These have been combined into the summary variable "Land Rights" and the combined relative impact potential is given in Figure 3-12. Note, this figure inverts the impact severity and has the larger impact at the bottom of the plot rather than the top.

To consider another view, Figures 3-13, 3-14, and 3-15 show how land rights issues vary with force size.

These type plots will be available for all variables and can be used by the system designer to consider environmental impacts in developing basing mode designs.

Overview of Results (3.2.4)

Comparison of the four candidate basing modes indicates that the level of impacts associated with each option is roughly the same for each particular BMCA. Each basing mode offers certain advantages and disadvantages for particular environmental concerns, but impact potential varies significantly, more by site than by basing mode, and no consistent pattern of environmental impacts leading to a preferred basing mode can be discerned. Therefore, selection of a basing mode must be made in concert with other engineering and cost considerations.

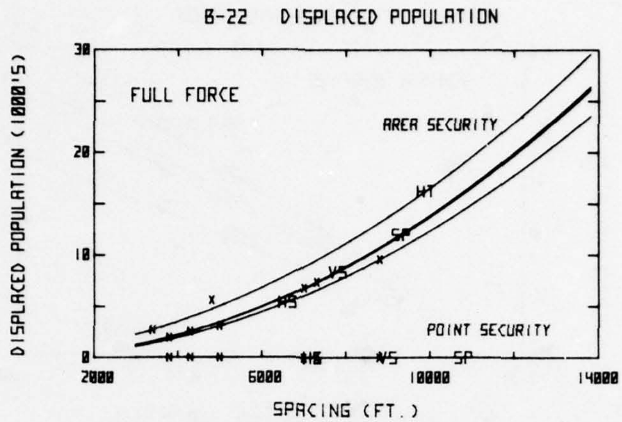


Figure 3-10.

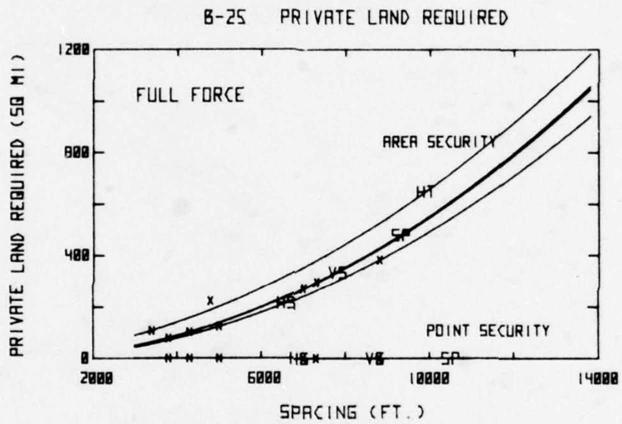


Figure 3-11.

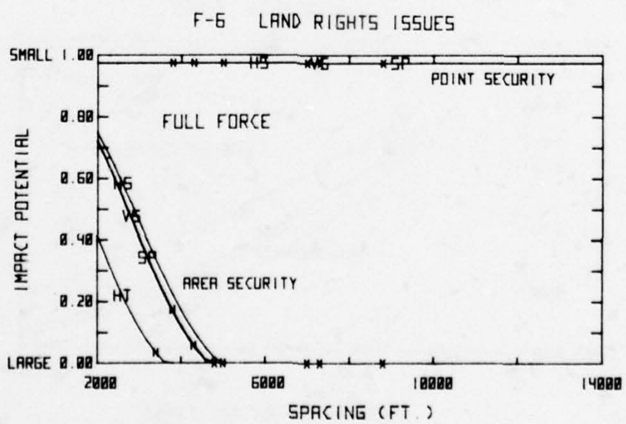


Figure 3-12.

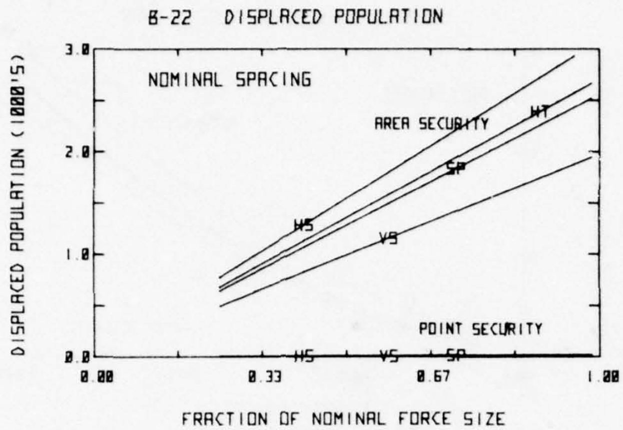


Figure 3-13.

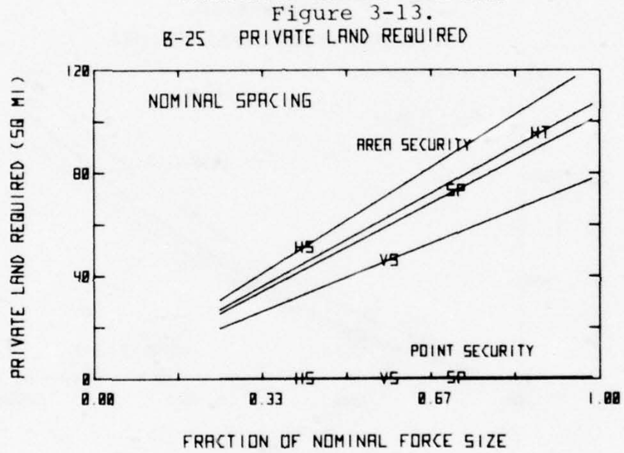


Figure 3-14.

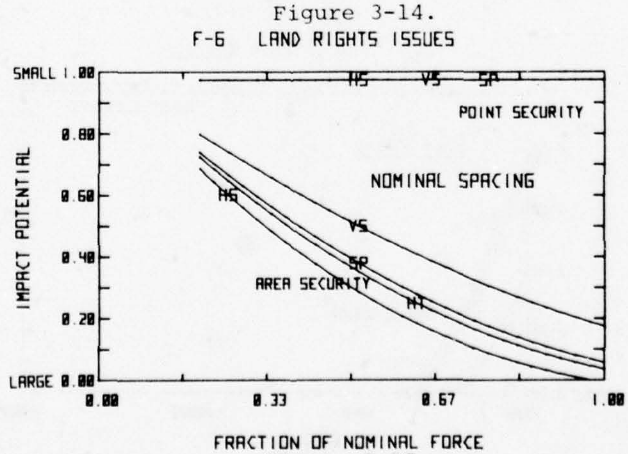


Figure 3-15.

Interference with Important Species (3.2.5)

Potential impacts to important plant and animal species, particularly species which are legally protected as threatened or endangered species are an important issue. Aquatic species may be influenced by water use. Protected species of small terrestrial animals and plants may be adversely affected by surface disturbance within the deployment area. Fencing requirements, particularly for area security, may interfere with populations of large animals by restricting their movements. The analysis of interference with important species summarizes the potential for impacts to populations of small animals which are protected by state and federal endangered species statutes, plant species which are proposed for similar protection, aquatic habitats of legally protected species, and potential interference with large mammals due to fencing.

Small species of terrestrial animals will be adversely affected by disruption of habitat areas during MX construction activities. Many species, particularly small birds and mammals, will tend to recover quickly following construction. A more substantial potential exists for impact to species protected by state or federal endangered species regulations. Because of restrictive habitat requirements, low reproductive success, competition with exotic species, or other ecological stresses these species are more sensitive to additional disturbances.

The number of small animal species likely to be affected by MX deployment is dependent on the size and location of the deployment area. The number of protected species varies greatly between regions. Within a region, the number of populations of protected species which may be influenced will increase with increases in the size of the deployment area. Most rare species have high site specificity and restricted distributions which vary greatly between valleys or within a region. This fact limits the precision of analyses of impacts to protected species for a comparison of basing modes.

Small animal species may be affected by MX deployment through direct injury, destruction of habitat by removal of vegetation or disruption of burrows, and by displacement due to noise, dust or other effects of construction activities. Thus, the threat to these species is dependent upon the size of the deployment area and the intensity of surface disturbance caused by construction activities.

The level of threat to protected small animal species is determined by the number of protected species in each BMCA which may be adversely affected by surface disturbance. The number of protected species likely to be present in each BMCA was determined using current information from the U.S. Fish and Wildlife Service, state fish and game agencies, and ecological information provided by other state and federal endangered species programs and personnel. Although the spatial relationships of

populations of protected species are complex, the number of populations and therefore, the potential for adverse impacts to these species increases monotonically with increasing deployment area size. For this analysis the relationship is presumed to be linear. For each BMCA the magnitude of the effect is adjusted for all basing modes to reflect the extent of surface disruption predicted as measured by the proportion of surface area within the deployment area which will be disturbed by construction of aimpoints, roads, and supporting facilities.

The impact potential is very similar for all but the South Platte and West Texas - Rio Grande BMCAs. The impact potential is greatest in the South Platte area due to the presence of the federally endangered black-footed ferret. Due to its critically low population level, impact to this species or habitats in current use could be significant. The protected species present in the West Texas BMCA are largely state protected reptiles currently threatened due to commercial exploitation for the pet trade and overcollection by amateur herpetologists, rather than loss or degradation of habitat.

Populations of rare plant species may be adversely affected by surface disturbance in much the same way as are small animal species. Plant populations will be most impacted by vegetation removal and habitat loss during construction. Populations outside the immediate area of disturbance may be affected by dust or by disruption of surface water drainage patterns which strongly influence vegetation patterns. The plant species of greatest concern are those which have been proposed for federal classification as threatened or endangered.

The analysis of potential for impact follows the same approach as that for protected small animal species. The threat to these plant populations is driven by the size of the deployment area and increases linearly with deployment area size and with the proportion of the area which is disturbed. Differences between BMCAs are determined by the number of candidate protected species present in geotechnically suitable areas.

Deployment of the MX system will require large quantities of water for concrete, dust suppression, compaction of fill, and many other uses. Many of the arid and semi-arid areas geotechnically suitable for MX deployment contain endemic fishes which are dependent upon the limited water supply in these areas. An increase in regional water use due to MX deployment may lead to reduction of aquatic habitats and lowering of the regional groundwater level if the rate of withdrawal exceeds recharge rates in these aquifers. A drop in the water table could lead to drying of springs or other water supplies which are necessary as habitat for aquatic species which are protected by state or federal law as endangered species. Populations of such species are present in areas such as Central Nevada, the California Mojave Desert area, and several drainage systems including the Colorado, Gila, and Rio Grande Rivers.

Magnitude of impacts will depend upon the rate of water use by the project or induced by the project, existing water storage and recharge rates, current water use patterns, and the extent and sensitivity of aquatic habitats. Water quality impacts to aquatic species and habitats are potentially important through increased silt loading which reduces primary productivity. This effect is considered under erosion potential. No problems due to nutrient levels or toxic materials are anticipated. Thus, the most significant potential for impact is through reduced water supply to protected species habitats.

The amount of water required for construction and operation expressed as a proportion of estimated regional groundwater storage is used as an index of potential for impact to aquatic habitats. An arbitrary period of ten years is used in the analysis although the bulk of water use occurs during the construction phase for all modes except the slope-sided pool. The greater the proportion of regional groundwater required for deployment the greater the potential threat to protected aquatic species.

Availability of groundwater is highly variable and even for localized aquifers precise estimates are difficult to obtain. Thus, results from this analysis are limited by lack of data in many of these areas. Recharge rates to the aquifers have not entered into the formulation of this variable. In areas where the recharge rates are high the groundwater storage will generally be large; in most other areas groundwater recharge is very low and the project would be supplied largely by "fossil" water.

The potential for impact to protected aquatic species, for a given proportion of groundwater use, is determined by the number of protected species present in a BMCA. The biology of the species influences the impact potential to a small extent in cases where large differences exist between species.

Impacts on large mammals will depend upon security requirements for fencing. Effects of fencing vary among species and areas. Bighorn sheep, for example, migrate seasonally between mountain ranges and fencing in the intervening valleys may restrict these movements. Fencing effects will vary between BMCAs due to differences in terrain and land use. Barbed wire fencing in presently fenced rangeland areas of the Great Plains would have relatively minor impacts upon pronghorn Antelope populations. The Sonoran subspecies of the pronghorn, federally protected as an endangered species, migrates more extensively due to the low and variable productivity in its Sonoran Desert habitat. Fencing in these previously unfenced areas may detrimentally affect this species.

The type of fencing utilized largely determines the magnitude of the impacts. Fencing which allows passage of wildlife (e.g., three-strand barbed wire or modifications) will have little effect. Fencing with lower proosity (e.g., tall chain-link fencing) will have a very large effect with a magnitude which will depend upon the nature, extent, and location of the fencing.

The requirements for fencing are not well delineated, especially in the case of area security. The type of fencing and layouts will be determined during FSED as studies continue on security requirements and intrusion detection systems. For this analysis it has been assumed that for point security high security chain link fencing will enclose two to three acres around each aimpoint and that area security will require an additional fence of barbed wire at the perimeter of the deployment area.

For each BMCA the magnitude of the effect of fencing is determined from estimates of the density of large mammals (including pronghorn antelope, deer, bighorn sheep, feral horses and burros, and coyotes). The levels of the effect are adjusted to reflect differences in terrain which influence to amount of fencing required and the area over which animals may be influenced.

The potential for impact which is associated with a given effect level is determined by the sensitivity of the species in each region. Deer and antelope in the Great Plains will not be greatly affected by barbed wire fencing while the impact upon the endangered Sonoran pronghorn at Luke AFR may be substantial.

Results of the analysis indicate that the vertical shelter mode poses the lowest potential for impacts to important species largely because of its low area requirement in nominal configuration. The pool concept with its high water requirement could influence aquatic species by decreasing the extent of aquatic habitats. Expanded spacing has greater requirements for size of the deployment area, surface disturbance, and water and has a moderate to large potential for these impacts for all basing modes in all BMCAs. There is a large component of statistical uncertainty in the analysis. The relative impacts for various project configurations in different areas can be predicted with greater precision than the absolute impact potentials.

Impacts on protected aquatic species are site-specific, with the highest potential for impacts occurring in desert areas of Nevada and California. These areas support many isolated endemic populations of rare, protected fish species whose survival depends on a limited water supply that can be affected by groundwater withdrawal. The pool basing mode, with its large water requirement ($\approx$0.3 million acre-feet [400 million m^3] for construction and 10 years operation), poses the greatest threat to these species; trench and shelter modes have much smaller estimated requirements, $\approx$30,000 acre-feet (40 million m^3). Expanded spacing significantly increases the water requirements but would also allow tapping of a larger overall groundwater reservoir, possibly reducing effects on groundwater in any one place within the deployment area. The hydrology of the water supply of the individual habitats is complex and specific studies appear to be necessary on a case-by-case basis to determine impact potential.

The potential for impacts on populations of plants varies greatly with site selection. The highest impact potential is in the desert areas of Nevada, California, and West Texas. Impact potential in other BMCAs is very low. At a given site, impacts are determined by both the amount of surface disturbed, and the area over which the disturbance is spread. Reducing the number of aimpoints reduces the impact potential due to the smaller size of the deployment area and surface disturbed. The threat to rare plant populations is least for vertical shelter and greatest for the hybrid trench due to the greater extent of disturbance.

Potential threat to populations of threatened and endangered small animals shows the same trends for differences between basing modes and project sizes. Problems with these species would be greatest for deployment in West Texas due to the presence of a highly endemic group of reptiles which are protected by state law.

Area security fencing could stress large mammals (including bighorn sheep, pronghorn antelope, deer, "wild" horses, and burros) by restricting their movements and access to needed resources (seasonal range, water). Magnitude of impact is site dependent. Vertical shelter with a fenced area of about 3,000 sq mi would be expected to have the smallest effect. The pool, hybrid trench, and horizontal shelter with fenced deployment areas estimated to be 1.3, 1.4, and 1.5 times that of the vertical shelter would be expected to have larger effects. In many cases, however, other site-specific considerations could outweigh these differences.

If security considerations require the use of chain-link or other fencing which more greatly restricts the movement of wildlife, the potential for impacts would be much greater. High security fences in southern portions of the Sonoran Desert could adversely affect the endangered Sonoran pronghorn.

In general, the slope-sided pool appears to have the greatest potential for impacts to important species due to large area and water requirements. The vertical shelter mode has the lowest potential for impact to important species due to smaller area requirements and reduced surface disturbance compared to the hybrid trench and horizontal shelter modes.

Air Quality (3.2.6)

Dust (Construction). Airborne dust is a nuisance, causes visibility degradation, and, in large quantities, can be a hazard. It is measured on an intermittent basis at most sampling stations throughout the country to provide 24-hour averages. Dust generated by construction activity can be heavy and cause significant mitigation problems in order to maintain

presently established air quality standards. Wind blowing over disturbed areas can pick up large quantities of dust and carry them long distances.

Vehicle-generated dust levels are estimates based on emission factors identified in a few controlled studies and depend strongly on vehicle type, road surface, road material, vehicle speed, and several other variables. Dust from handling and moving large quantities of soil varies over a wide range depending on soil composition and moisture content. The emission factors used in calculating dust levels are not well defined either for vehicles or soil handling due to the wide possible range of parameters.

A good many factors affecting the quantities of dust generated by physically disturbing the soil surface and wind blowing over it are known only to very broad approximations. The quantities estimated for wind-blown dust may be off by factors of 10 and 100 and construction dust is probably no better known. Impacts estimated from these first order approximations are useful in a relative sense, but a firm quantitative evaluation must await further detailed studies.

In order to assess an impact, it is first necessary to determine a background or baseline concentration level of dust (particulate) in each of the BMCA regions. This background concentration level is determined by examining existing monitoring data within each of the BMCA regions and assessing, based on measured results, meteorological parameters, topography and population parameters, a representative background concentration through each BMCA.

Local air quality regulations for dust vary by state with a least restrictive limit being the National Primary standard of 260 $\mu g/m^3$. These standards do not restrict the amount of dust that can be generated at a particular site, but limit the atmospheric concentration of dust at a receptor. The most restrictive standard is a 100 $\mu g/m^3$ limit at the Mojave Desert BMCA in California, the Luke/Yuma BMCA in Arizona and the White Sands BMCA in New Mexico. The BMCAs with particulate standards equal to the National Secondary Standard of 150 $\mu g/m^3$ are the Nevada Great Basin BMCA, the Texas High Plains BMCA, and the South Platte Plains in the states of Nebraska, Kansas, and Colorado. The least restrictive standard, equal to the National Primary Standard of 260 $\mu g/m^3$, is within the West Texas BMCA.

In order to estimate the amount of dust which will be generated due to the construction of the MX facility a physical characterization of each BMCA must be made. This includes for each BMCA a soil summary including moisture content, type of regional topography, the natural vegetative cover, and a description of the agriculture performed in the region. With this information, estimates of dust generation can be made by correlating the type of BMCA to empirical dust generation studies published by the EPA.

Using this dust generation term and assuming a horizontally even concentration distribution with a logarithmic concentration distribution in the vertical to a height equal to the lowest mean mixing height for the area, an approximation of the dust concentration at the surface throughout the BMCA can be made.

The results of this analysis show which basing modes cause the greatest impact on dust concentration, and the areas which have the greatest potential for dust generation. From this analysis it appears that the Mojave Desert BMCA has the greatest estimated increase in dust concentration of about 87 $\mu g/m^3$ for all of the proposed basing modes except the hybrid trench, in which case the South Platte Plains experiences the greatest dust concentration increase of approximately 103 $\mu g/m^3$. For all of the basing mode configurations, the Luke/Yuma BMCA has the lowest estimated dust concentration increase of approximately 28 $\mu g/m^3$.

The type of basing mode which appears to have the greatest impact on dust concentrations is the hybrid trench expanded spacing. The impact potential ranges between 1 (small impact) and 0.890 for all the BMCAs except the Mojave Desert BMCA in California which has an impact potential of 0.119. The large impact potential from this area is due mainly to the very strict air quality standard for dust (100 $\mu g/m^3$) and the large expected increase of dust concentration (90 $\mu g/m^3$). The type of basing mode which appears to have the least impact on dust concentrations is the vertical shelter, nominal spacing, point security. For this mode only the White Sands BMCA in New Mexico and the Mojave Desert BMCA in California, with impact potentials of 0.977 and 0.595, respectively, show any impact from the concentration of dust.

By reducing the total deployed missile force in any of the areas regardless of the basing mode, the increase in dust is only slightly reduced over the increase in dust for full force deployment. The average decrease in added dust concentration resulting from a 1/3 reduction of the full force is only about 1 $\mu g/m^3$ for all basing modes in all areas. The average decrease of dust resulting from a 2/3 reduction of the full force is about 1.5 $\mu g/m^3$ for all basing modes in all areas. This estimated change is very small and indicates that the impact potential for construction related dust changes little with the change in total deployment.

Pollutants. Four combustion-related pollutants have considerable significance in the basing mode comparison analysis. These are nitrogen oxides (NO_x), sulfur dioxide (SO_2), hydrocarbons, and carbon monoxide (CO). Background or ambient concentrations are measured at discrete locations and such measurements are accurate and reliable. They give a reasonable picture of specific conditions but tell little of wider areas located away from the sampling points. Here field measurement data are required in order to fill in data-sparse areas and to complete the air quality picture. Such measurements were not available for the present study and

thus the results presented here are tentative and only suggestive of the real values. Also, the present analysis does not consider the existence of a major operational base which would house personnel associated with the project and would generate quantities of the four pollutants considered here.

Nitrogen Oxides (Construction. Nitrogen oxides are produced by combustion processes both internal and external. Background concentrations tend to be low except in urban areas where vehicle use is heavy. The federal standard is based on nitrogen dioxide, which can have physiological effects in high concentrations.

Measured data from source agencies, summarized and published by the EPA, provide the most useful areawide nitrogen oxide information. The stations most representative of the area to be examined were selected for inclusion in the background concentration data. Project data was estimated from vehicle emissions as a function of vehicle miles traveled and heavy equipment operating hours. Stationary power source emissions were calculated from fuel use estimates.

The background data is sparse and not well located to specify present conditions outside of urban areas. Project emissions estimates are not well defined at this time, resulting in air quality concentration values that are broad estimates of upper limit values rather than specific bounding values.

Site-specific Difference:

Central Nevada Great Basin:	maximum NO_x projected is 12 $\mu g/m^3$
Mojave Desert:	maximum NO_x projected is 12 $\mu g/m^3$
Luke/Yuma:	maximum projected NO_x level approximately 32 $\mu g/m^3$
White Sands:	maximum projected NO_x is 12 $\mu g/m^3$
West Texas:	maximum projected NO_x is 12 $\mu g/m^3$
Texas High Plains:	maximum projected NO_x level approximately 25 $\mu g/m^3$
South Platte Plains:	maximum projected NO_x level approximately 25 $\mu g/m^3$

Nitrogen oxide concentrations from any project configuration do not exceed 30 $\mu g/m^3$ on the average. Since most non-urban background

concentrations are low, the concentrations computed here, which include the low backgrounds, are effectively just those of the project. The vehicle and external combustion emissions sources distributed throughout the project area result in concentrations that range upward from 2 $\mu g/m^3$ or less in Nevada to the 30 $\mu g/m^3$ expected in Arizona. Since the volume into which the pollutants mix and the amount of pollutant generated are both functions of the size of the project area, there is little difference between concentrations of nitrogen oxides computed for full force or 1/3 force deployment. Neither generates a large impact in terms of ambient average concentrations. The impact potential for any of the comparison areas, since their nitrogen dioxide levels are well below the national standard of 60 $\mu g/m^3$, is small.

Sulfur Dioxide (Construction). Sulfur dioxide (SO_2) is a pollutant produced by burning fuel containing sulfur and is a problem in some areas. Criteria have been established by the EPA for SO_2 concentrations in the air that should not be exceeded for health reasons. In the areas examined under the present project, sulfur dioxide sources are confined to power plants or smelters and present problems only in their immediate area.

Available measured data are routinely provided to the EPA by the state level primary agency. The data subsequently published by the EPA were surveyed to estimate the general sulfur dioxide concentration levels for each area. Maximum concentration values from representative sampling stations were examined along with other available data to compile the most useful data set. Project increments were scaled from fuel use estimates and expected distribution patterns of construction workers. Vehicle mileage included an approximation of the average home-to-work trip distance for the workers in the construction area.

Site-Specific Difference:

Nevada Great Basin:	Limit is 285 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 17 $\mu g/m^3$
Mojave Desert:	Limit is 100 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 4.0 $\mu g/m^3$
Luke/Yuma:	Limit is 285 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 77 $\mu g/m^3$
White Sands:	Limit is 285 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 15 $\mu g/m^3$
West Texas:	Limit is 365 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 11 $\mu g/m^3$

Texas High Plains: Limit is 285 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 18 $\mu g/m^3$

South Platte Plains: Limit is 15 $\mu g/m^3$; project air quality levels of SO_2 are not projected to exceed 4 $\mu g/m^3$

Sulfur dioxide emissions for all configurations and spacing options of the project are based on fuel use. Little variation is seen between the options investigated at any of the BMCAs, which included horizontal shelter, vertical shelter, pool, and trench concepts for both area and point security. The location showing the greatest concentration of sulfur dioxide is the Luke/Yuma, Arizona BMCA where values around 76-77 $\mu g/m^3$ are projected for the full force deployment scenario. This figure includes an estimate of present background levels of SO_2 in Arizona. For the 2/3 and 1/3 force sizes, the concentrations change only fractionally since the volume of air into which the pollutant is distributed is assumed to change proportionately with a change in deployment area. The BMCAs show individual differences with the South Platte Plains area showing the smallest concentration, about 2 $\mu g/m^3$.

Since the standard for sulfur dioxide concentrations is 285 $\mu g/m^3$ in Arizona, the total of 77 $\mu g/m^3$, effectively generated by the project there, does not appear to be a critical value. The much lower standard in the South Platte Area, where the SO_2 level is set at 15 $\mu g/m^3$, does not appear to be much of a problem either, as the projected concentrations are so much lower than in Arizona. Part of the explanation for the projected concentrations being so different is the difference in meteorology and the ability of the atmosphere to dilute pollutants. Air flow in the South Platte area is more constant, providing much better average pollution dispersion there than in Arizona.

Hydrocarbons (Construction). Hydrocarbons are emitted by vehicles and, through evaporation of liquid fuels, from storage areas. Reactive hydrocarbons enter into photochemically-active processes producing oxidants and ozone, which are important pollutants in urbanised areas. The transport of ozone over long distances is possible and could be an important consideration in air quality determinations in non-urban areas. Transport of hydrocarbons to locations where ozone may form is similarly a concern and requires information on source locations and emission levels.

The available measured data provided to the EPA by agencies from the various states is published by the EPA. These were surveyed to estimate the general hydrocarbon concentration levels for each area. Data from representative stations were selected and used to determine the average values used in the area evaluation. Project air quality effects were estimated using projected vehicle mileage and EPA emission factors.

The amount of fuel used during construction was estimated and converted to expected emission levels to back up the mileage computations and provide a basis for estimating stationary source emissions.

Hydrocarbon standards are set at 160 $\mu g/m^3$ nationally but vary down to half this value in some of the states.

Site-Specific Difference:

Nevada Great Basin:	Limit set at 160 $\mu g/m^3$; less than 10 $\mu g/m^3$ is projected
Mojave Desert:	Limit is set at 160 $\mu g/m^3$; less than 10 $\mu g/m^3$ is projected
Luke/Yuma:	Limit is set at 80 $\mu g/m^3$; less than 25 $\mu g/m^3$ is projected
White Sands:	Limit is set at 80 $\mu g/m^3$; less than 10 $\mu g/m^3$ is projected
West Texas:	Limit is set at 160 $\mu g/m^3$; less than 10 $\mu g/m^3$ is projected
Texas High Plains:	Limit is set at 130 $\mu g/m^3$; less than 40 $\mu g/m^3$ is projected
South Platte Plains:	Limit is set at 160 $\mu g/m^3$; less than 20 $\mu g/m^3$ is projected

The range of hydrocarbon concentrations from construction related emissions is quite small for all basing modes and force structure options. The most significant difference occurs between the Nevada area with 1.0 $\mu g/m^3$ and 30 $\mu g/m^3$ for the Texas High Plains area. This same range appears for all basing modes. The reason for the relatively consistent effect is that the basis of computation was the combined fuel use estimates and the construction vehicle mileage estimates for the project. These do not vary much with the basing mode, but the combination does vary (by about a factor of thirty) from one geographic location to another. This reflects differences in site access distance, distance to population centers, and availability of commercial power.

The impact level for all the various combinations of force level, area or point security, vertical shelter construction, horizontal shelter construction, or trench mode construction is not large. The maximum expected increment of 30 $\mu g/m^3$ in the Texas High Plains, occurs in an area with basically very low non-urban hydrocarbon concentration levels.

The established standard for the area is 130 μg/m^3 . The project air quality increment plus the background concentrations is well below this with a maximum of 30+ μg/m^3 for the full force trench mode with expanded spacing. For the areas within states with lower hydrocarbon concentration standards such as New Mexico and Arizona with their 80 μg/m^3 limits, the maximum expected hydrocarbon values related to the project are around 20 μg/m^3. Controls on project related emissions of hydrocarbons from fuel storage locations and local planning to minimize vehicle emissions: by reducing vehicle use (car pools or buses to the work area, for example); by reducing as much as possible the onsite mileage for all equipment, and by using general energy conservation practices could provide a further reduction in the already low level of hydrocarbon emissions.

Carbon Monoxide (Construction). Carbon monoxide is a vehicle and/or combustion related pollutant that is found in small quantities outside of urban areas. In vehicle-dense areas, levels increase but only in exceptional circumstances are established standards exceeded.

Vehicle emissions estimates are dependent on speed, age of vehicle, kind of vehicle, etc. They are not high accuracy numbers at best, and in most circumstances serve only as potential problem indicators. None of the areas examined showed values close to the national standards with most project emissions levels resulting in airborne concentrations up to about one-fourth of the standard.

For vehicle emissions, the emission factors published by the EPA were used to estimate the amount of carbon monoxide produced by the project vehicles for assumed activity levels. Routinely measured data are profuse in urban areas, but much less so in non-urban areas. Baseline values from the EPA published data summaries were used to establish background pollutant levels.

Local air quality regulations for carbon monoxide are identical to the National Standards in all the states encompassing the BMCAs. These regulations set the carbon monoxide standard at 10,000 μg/m^3 averaged over an eight-hour period.

Analysis shows that the differences in the carbon monoxide increase between the BMCAs is negligible. There is a difference, however, between the different basing modes. The estimated concentration increase is negligible for all of the basing modes except the hybrid trench. In this case the impact potential ranges between 1.0 (no impact) and 0.02 (large impact).

By reducing the total deployed missile force in any of the BMCAs regardless of the basing mode, the general increase of carbon monoxide is only slightly reduced over the increase of that for full force deployment. One reason for this small change is that the volume of atmosphere

the carbon monoxide is mixed in changes in direct proportion to the total carbon monoxide emissions when the deployment force size changes, which results in a very small change in the overall concentration of carbon monoxide. The other reason for the small change is that carbon monoxide is almost entirely a vehicle-generated pollutant. Sources other than the vehicles do not enter strongly into the pollution effects, so that emissions change directly according to the number of workers, i.e., vehicles involved.

Dust (Post-Construction). Dust generated subsequent to completion of construction will be primarily wind erosion effects on the disturbed area. Variable wind speeds and seasonal changes in rainfall and storms affect the amount and distribution of this type of dust. Mitigative measures that bind the surface layers together are more or less effective on various kinds of soil. Wind-blown dust can be a large factor in visibility reduction and has also had significant economic impacts in terms of soil lost from productive lands prior to the start of crop growth or revegetation.

The wind erosion equation developed for agricultural soil loss by the USDA was adapted for use in a more general context and used to estimate the dust potential for the disturbed areas. The resulting estimates also depend heavily on soil type, condition, and surface slope which were generalized for each disturbed area. The airborne dust load also varies with wind speed which was taken as the annual average for each area. The generalized assumptions used to define the wind-borne dust problem result in a concentration estimate that is probably within an order of magnitude. What data are available are not adequate for more precise determinations at present. Field data acquired in sample locations could help to refine the estimates and would provide an improved level of confidence. The differences discussed in the impact evaluation section between one mode and another or between one area and another are indicative of generally improved or generally worse conditions even though the differences are numerically small. Where the impact potential is below 0.7, a definite decrease in air quality would be expected. Between 1.0 and 0.7, an occasional day may be poor but most days would be good.

The relative impact potential for dust pollution increases in a nonlinear fashion. The general shape of the curve is established to fit the primary and secondary national standards, so that impact potential is large above the primary value (260 $\mu g/m^3$) and small below the secondary value (150 $\mu g/m^3$). This results in a potential impact curve that sharply increases as the primary standard is approached.

Site-Specific Difference:

Nevada Great Basin:	primary standard is 150 $\mu g/m^3$ maximum projected dust is 57 $\mu g/m^3$
Mojave Desert:	primary standard is 100 $\mu g/m^3$ has lowest acceptability of any site for dust maximum projected dust concentration is 90 $\mu g/m^3$
Luke/Yuma:	primary Standard is 150 $\mu g/m^3$ maximum projected dust level is 30 $\mu g/m^3$
White Sands:	primary standard is 100 $\mu g/m^3$ maximum projected dust level is 61 $\mu g/m^3$
West Texas:	primary standard is 260 $\mu g/m^3$ maximum expected is 69 $\mu g/m^3$
Texas High Plains:	primary standard is 150 $\mu g/m^3$ maximum expected is 56 $\mu g/m^3$
South Platte Plains:	primary standard is 150 $\mu g/m^3$ maximum expected is 77 $\mu g/m^3$

Although the impact of dust, primarily wind generated, subsequent to completion of construction is usually minor from a regulatory compliance (i.e., dust control) standpoint, it could in some instances be of concern. Dust picked up from a disturbed surface, even if the surface has been restored to nearly its original configuration, can be distributed widely by the wind and cause increased background levels. For large disturbed areas, local dustiness may increase and cause a decrease in visibility. Background dust (particulate) levels also may increase to the point where air quality limits may be approached or occasionally even exceeded. For some of the states that have established particulate limits of 100 $\mu g/m^3$ for their primary standard, these potentially increased dust concentrations may be a matter of concern. Examination of the results of the post construction dust analysis show that the only location where a significant increase in impact potential occurs due to dust from the disturbed construction area is in the Mojave Desert region in California. The White Sands area shows some effect but it is so small.

The largest operational impact potential for any of the basing modes occurs with the full force deployment in the vertical shelter mode, expanded spacing, under a point security concept. For this combination, the California region shows a numerical value of impact potential of 0.48 for the vertical shelter program and expanded spacing. The trench basing mode with area security has a computed impact potential of 0.61, which means it has a much lower impact potential for this region than the

vertical shelter does. One interpretation of this is that the post construction dust is more effectively mitigated for the trench basing mode than for the vertical shelter mode. In addition the amount of disturbed soil not covered by road pavement or facilities (including parking areas) is smaller for the trench mode than it is in the vertical shelter mode, particularly under an expanded spacing configuration which covers about 45 mi^2 (120 km^2). The overall effect of these considerations is that the average particulate concentration for the wind-blown post construction dust is 86 $\mu g/m^3$ for the expanded spacing trench-area security mode and 90 $\mu g/m^3$ for the vertical-shelter/point security combination. For nominal spacing and an area security concept the concentrations are 85 $\mu g/m^3$ for the trench and 87 $\mu g/m^3$ for the vertical shelter, again showing a slight advantage for the trench in post construction dust potential. For the vertical shelter mode with nominal spacing, area security results in an average particulate concentration of 87 $\mu g/m^3$ while the point security concept results in an average 88 $\mu g/m^3$ concentration.

In the other BMCAs there is little distinction between basing modes, security concepts or spacing designations on an impact potential basis; all modes have small impact potential due to post-construction dust generation. Air quality limits would not be exceeded due to wind-blown dust from the operational locations. In areas outside of California with reduced force deployments the post-construction dust potential is also reduced. California retains an impact potential for reduced forces that is substantially the same as for the full force.

The lowest average post-construction dust level occurs with area security and the trench basing mode in the West Texas-Rio Grande area. An average of only 48 $\mu g/m^3$ results from the wind-disturbed surfaces in this area for the 1/3 force deployment concept.

Water Quality and Supply (3.2.7)

Water considerations related to construction and operation of MX are of primary significance. Water demand for construction, dust suppression, sanitary use, human consumption, etc. is expected to be considerable. With the climate of large portions of the western United States arid or semi-arid, water demand often exceeds supply. In addition, the majority of present and future water supplies are fully allocated. With a low surface supply and near total allocation, groundwater becomes the only long-term source in most BMCAs.

Estimation of water availability is based upon the concept of safe yield. This implies that waters utilized are replenished and over-drafting does not occur. The accuracy of estimates are tied to knowledge of water supply over the entire area of study. With information gaps in many regions resulting from insufficient or non-existent inventories, errors of 25 percent or larger are to be expected.

The estimated net available water for the seven BMCAs is shown in Table 3-5. From this table, it can be seen that the West Texas BMCA has the largest water surplus with South Platte having about one-half of this amount. Other BMCAs have much less. The Texas *High Plains* is a "worst case" in having no available water while Luke/Yuma is nearly as deficient. A point that should be noted is that while water may be physically available, legal impediments may hamper routine acquisition in other than narrowly prescribed applications. If the Air Force lacks priority in water uses, the purchase of water rights would be required.

The degree to which a BMCA is suitable, in terms of water quality and supply, depends upon the ratio of water supply to water demand. The most favorable ratio is one where supply greatly exceeds demand with the least favorable ratio being the opposite one.

Table 3-5. Estimated net physically available water for BMCAs.

SITE	ESTIMATED AVAILABLE WATER IN MAF* (10^6 m^3) PER YEAR		ESTIMATED WATER BEING USED IN MAF (10^6 m^3)/YR		ESTIMATED NET WATER AVAILABLE IN MAF (10^6 m^3)/YR	
A Central Nevada	0.8	(9.9)	0.6	(7.4)	0.2	(2.5)
B California Mojave	0.7	(8.6)	0.6	(7.4)	0.1	(1.2)
C Luke/Yuma	0.078	(0.96)	0.07	(0.86)	0.008	(0.1)
D White Sands	2.8	(34.5)	2.2	(27)	0.6	(7.4)
E West Texas	22.4	(276.3)	15	(185)	7.4	(91.3)
F Texas HP	0.02	(0.25)	0.02	(0.25)	-	-
G South Platte	15	(185)	12	(148)	3	(37)

The numbers here are estimated values derived from U.S. Water Resources Council data. The rest are estimated values. Total availability estimates include both surface and groundwaters.

*MAF = million acre-ft.

In considering variation in water demand with changes in project configurations, the pool concept with point security, full force, in expanded spacing requires the maximum water, approximately 380,000 acre-ft (460×10^6 m^3). The vertical shelter, area security, 1/3 force in nominal spacing requires the least, 9,000 acre-ft (11×10^6 m^3). These figures are totals for the full period of 15 years. Values for the other configurations fall with the lower end of the range.

Loss of Recreational Access (3.2.8)

Two considerations are discussed in this issue: the potential withdrawal of presently open public land from public access, and the disruption of access to recreational areas. All BLM managed lands are current or potential recreation areas. The amount of such land required for the project thus impacts recreation resources. The amount of publicly owned land required varies with siting area, basing mode, the spacing, and particularly with the security system. The South Platte and Texas-New Mexico High Plains areas are essentially all privately owned. The western areas, particularly Nevada, California, Arizona, and New Mexico have extensive public non-DOD lands; the West Texas has a much lower proportion of public lands. With the area security configuration, the extremes in areas containing public domain land range from 2,400 mi^2 (6,200 km^2) for vertical shelter with nominal spacing in West Texas to 17,600 mi^2 (45,600 km^2) for horizontal shelters with expanded spacing in the California Mojave. The reduction in exclusive land requirements afforded by the point security configuration is dramatic (less than 1.0 percent of area security requirements).

Deployment over a large area may impact recreation resources by interrupting access to off-site recreation areas in nearby regions. In area security, it may be necessary to interrupt existing direct access across the deployment area. Existing roads may be blocked, requiring circuitous access at best and perhaps eliminating practical access altogether. Point security will allow relatively greater access to and through the area but the extensive network of roads required could act as a partial barrier to nearby recreational areas. Circumventing these barriers may increase trip length (whether by foot, horseback, off-road vehicle, or family automobile) and may discourage the trip or change common destinations. This could result in increased utilization and congestion at other recreation areas. To a very large degree, these impacts depend on the actual siting areas selected.

Natural Resources (3.2.9)

Aesthetic degradation is very difficult to quantify and so judgments of potential impacts should be looked upon as indications of potential problems or controversy rather than absolute facts.

In assessing aesthetic degradation, two subjective judgment ratings were applied. First the seven sample BMCAs were rated on a scale which varied between "pristine naturalness" on one end and "highly disturbed" on the other. Second, the basing mode system was evaluated to indicate how a given number of deployed aimpoints would rate an otherwise pristine area on the same scale. Each basing mode was rated against this scale.

The conclusions can be summarized as follows:

- Highly agricultural regions do not suffer significant impacts by MX deployment
- Relatively unspoiled natural areas have significant potential for aesthetic impacts from MX, but this impact is not amenable to rigorous quantification. The uncertainty involved in interpreting these impacts is quite large.
- The trench mode has the most disturbed area during construction, with the least paved area; however, this mode has the greatest potential for revegetation.

Loss of vegetation is an important variable which influences plant community structure, availability of food and cover for wildlife, and potential for soil erosion by wind and water. Deployment activities including grading, trenching, and construction of roads and facilities will remove between about 120 and 300 sq. mi (310 and 780 km^2) of vegetation for the nominal project configuration (Table 3-2). The effects of this disturbance will be negligible in cultivated croplands. In other areas the magnitude of the impact will be directly related to the extent and intensity of the disturbance.

The effect of surface disturbance is related to the proportion of each BMCA which is not under cultivation. The extent of cropland in each area was estimated from data available in the most recent Census of Agriculture State and County Data Books (1977). This estimate does not consider other regularly disturbed areas, such as mining areas, but is sufficiently accurate for basing mode comparison.

Impacts resulting from removal of vegetation include loss of primary productivity, displacement of animal populations, disruption of plant and animal communities and increased erosion potential. The loss of natural habitat which results from MX deployment is dependent upon the intensity and extent of disturbance caused by construction and the abundance of similar habitat in the United States. For a given level of disturbance in a habitat the effect will be greatest for habitats of small areal extent. The relative impact potential is determined by the existing degree of disturbance in the region and the potential for the habitat to restore itself following deployment. The biological value of an area as a natural habitat is based upon its rarity and pristine character and loss of value caused by disturbance depends upon the rate of habitat restoration.

The habitat loss in each BMCA is determined by the size of the deployment area expressed as a proportion of the area of the major habitat type which the BMCA represents. Major habitat divisions are shown in Figure 1-9. The effect of deployment in the widespread Southern Great Plains would be less than that from deployment in the Mojave Desert habitat due to the much smaller size of the latter. The magnitude effect is adjusted relative to the proportion of the surface disturbed within a deployment area, which varies with basing mode.

Relative impact potential is determined by the index of existing disturbance within the region (Figure 3-16). This index reflects the degree of human induced changes in the natural environment. Relative impact potentials incorporate estimates of the recovery potential of the habitat. Impacts on natural habitats will be much smaller in a relatively disturbed habitat with high recovery potential than in a pristine area which recovers very slowly. The impact potential is limited by the existing disturbance condition in the region.

Biological and aesthetic impacts associated with vegetation removal are greatest in undisturbed desert areas in the Southwest and least in intensively cultivated or otherwise disturbed areas. At a given undisturbed location, impacts depend on size of the total deployment area and the size of the area within it from which natural vegetative cover is removed. Estimated disturbed areas range from about 120 mi^2 (310 km^2) for vertical shelter to 300 mi^2 (780 km^2) for inline hybrid trench. These disturbances would be spread over a total area (excluding intervening mountains and otherwise unsuitable areas) ranging from 4,000 mi^2 (10,400 km^2) for vertical shelter to 6,200 mi^2 (16,000 km^2) for horizontal shelter. Expanded spacing increases the disturbed area by approximately 20 percent (inline hybrid trench) to 50 percent (vertical shelter) due to increases in the length of the road network, and would increase the area over which the project was spread from 70 percent for the inline hybrid trench to about 200 percent for the three shelter modes. Deployment in a presently or previously cultivated area reduces impacts to natural resources significantly with corresponding increases in socioeconomic impacts.

Vegetation removal appears greater for the hybrid trench basing mode and will be approximately 285 mi^2 (740 km^2) for nominal spacing and may be as much as 400 mi^2 (1,040 km^2) for expanded spacing. Compensating somewhat for the larger surface disturbance with the hybrid trench is the revegetation that would occur over much of the disturbed surface during project life. In contrast, a high proportion of the surface area in discrete aimpoint modes is heavy-duty road which would be maintained thus preventing revegetation for the life of the project.

The slope-sided pool and horizontal shelter have a greater potential for impacts than the vertical shelter mode. For all modes the expanded spacing option increases the amount of surface disturbance and the

RELATIVE BMCA DISTURBANCE: DEGREE OF HABITAT NATURALNESS

	1.00	Essentially pristine habitat, large continuous areas ungrazed and without roads or structures, limited recreational use.
Luke/Yuma		
	0.90	Habitat shows only minor disturbance with few roads, powerlines, weeds, etc.; vegetational or habitat changes (if any) confined to these local areas; light grazing, if any.
California Mojave		
Central Nevada	0.75	Changes due to livestock grazing limited to changes in relative cover of palatable vs. unpalatable species with no pronounced changes in physiognomy; area essentially natural habitat for wildlife, essentially no erosion due to human activity.
West Texas		
White Sands		
	0.50	Grazing intensity moderately heavy with evident but moderate invasion of woody vegetation. Loss of topsoil and early stages of arroyo cutting may be evident; structures and facilities common, limited cultivation; moderate changes in wildlife present—some sensitive species rare or absent. Unmistakeable habitat modification by man but essentially native flora and fauna, significant weed component.
	0.25	Habitat greatly influenced by human activity; cultivation common, rangeland heavily grazed with major vegetational changes; regular human use of nonagricultural areas evident, wildlife common to abundant but includes only species relatively insensitive to human disturbance.
South Platte		
Texas High-Plains		
	0.10	Cultivation widespread with limited grazing, or rangeland profoundly overgrazed; fauna limited to species commonly associated with man and agricultural activity.
	0.00	Extremely disturbed habitat.

Figure 3-16. Example of scoring system used to assess level of habitat disturbance and representative extimated scores for portions of different BMCAs. In practice, randomly selected biological sampling areas are scored using this system while other biological data are collected from the area. A measure of central tendency and confidence interval for each candidate siting area is then calculated from these data.

impact potential. Expanded spacing increases the surface area disturbed by 25 percent for the slope-sided pool, 50 percent for the vertical shelter, and about 35 percent for the other two modes. Conversely, the adverse effects may be reduced by reducing the numberof aimpoints.

Due to the slow rates of natural revegetation, the Mojave Desert and especially the Sonoran Desert are areas where potential adverse effects are greatest. Substantial habitat recovery requires at least 100 years in the Mojave and in excess of 150 years in the Sonoran Desert. Intensely cultivated areas of the plains states recover fairly rapidly following vegetation removal. Perennial grass cover is established within 5-10 years with substantial recovery within 25 to 50 years. These areas pose the fewest constraints to project siting due to impacts related to vegetation removal.

Loss of biological value of natural habitats is potentially large for all basing modes in all areas except in predominantly agricultural areas such as the Texas-New Mexico High Plains or the South Platte Plains.

The short and mixed grass plains of the Southern Great Plains is a habitat type of wide distribution (over 180,000 sq. mi [470,000 km^2]) which has been largely altered by agricultural activities. These areas show the lowest potential for impacts to natural habitat value. Deployment in the Sonoran Desert habitat of the Luke/Yuma area would cause much greater impact due to the smaller area of this habitat (45,000 mi^2 [120,000 km^2]) and the lack of disturbance over very large areas.

The analysis of habitat loss is limited by scaling in the ability to represent differences between basing modes and spacing and is most sensitive to the large differences between basing areas. For areas where impact potential is large, the analysis fails to indicate the large differences between basing mode and spacing options. The habitat loss will be directly related both to the size of the area over which the project is deployed and the extent of surface area disturbance. Thus, the vertical shelter mode will have much less impact than the other basing modes in which 1.5 to 2.5 times more surface area is disturbed within a deployment area 1.3 to 1.6 times larger. Expanded spacing which disturbs 1.2 to 1.5 times more area in a deployment area two to three times larger has a much greater impact potential in all areas.

Land Rights (3.2.10)

Area security requires large fenced land areas. These range from 4,000 mi^2 (10,400 km^2) for the vertical shelter mode in nominal spacing to 19,100 mi^2 (49,500 km^2) for the horizontal shelter in expanded spacing. Point security, however, reduces this requirement dramatically to 21 to 40 mi^2 (50-100 km^2), plus 90 to 250 mi^2 (233 to 650 km^2) for roads.

Area security will require relocation of people from the project lands. In rural areas with relatively high population densities this could range as high as 70,000 people for the horizontal shelter, expanded spacing in the South Platte area (Table 3-6). The minimum population displacement for area security is 2,000 people for the vertical shelter mode, nominal spacing in the Central Nevada BMCA.

The relative impacts among the BMCAs are generally considered very large in the area security configuration. The impacts are only somewhat smaller in Central Nevada, California Mojave, White Sands, and West Texas-Rio Grande BMCAs when vertical shelter with nominal spacing is considered. Point security could significantly reduce the need to relocate people.

In the South Platte and Texas High Plains, the lands required are, in effect, substantially all privately owned while in the other BMCAs the geotechnically suitable lands are almost all publicly owned, either under the jurisdiction of BLM or DOD. Table 3-7 shows the area of private land that would be required for each of the 14 alternative projects in each of the seven BMCAs. Comparison of Table 3-7 with the total fenced land requirements of Figure 2-1 shows that all the required land in either the High Plains or South Platte BMCA is currently privately owned.

Local Economic Issues (3.2.11)

The annual direct construction labor requirement ranges from 8,500 people for the vertical shelter to 16,500 people for the trench, with horizontal shelter and slope-sided pool requiring 10,700 and 12,700 people per year, respectively. Expanded spacings increase requirements about 10-15 percent, except in the case of the hybrid trench where 40 percent increase is required. Direct construction labor represents the direct requirements of the project. Some, generally small, portion of this labor will be supplied by the local area, the precise number depending on the size of that portion of the local unemployed labor force that has suitable skills. In addition to the direct labor, however, jobs will also be created indirectly through the operation of the multiplier effect in the local economy. Indirect job generation also provides jobs for local residents. Indeed, given the fact that these jobs will generally be the same kinds of jobs as those that currently exist in the economy, most of the local jobs associated with the project will result from the indirect economic activity that is created.

For several areas, the local labor pool is sufficiently small that the jobs provided for local residents is independent of mode, force size, or spacing and security configuration. This is the case for Central Nevada, South Platte, and White Sands. In contrast, the more populated areas of Luke/Yuma and California Mojave will provide substantial portions of the indirect labor requirements from their existing population.

Table 3-6. Displaced population.

BASING MODE CONFIGURATION	CENTRAL NEVADA	CALIFORNIA MOJAVE	LUKE/YUMA	WHITE SANDS	WEST TEXAS	HIGH PLAINS	SOUTH PLATTE
Area Security							
Horizontal Shelter							
Nominal Spacing	3,000	11,700	18,500	12,400	10,500	21,600	21,600
Expanded Spacing	9,600	36,300	57,400	38,300	32,500	66,900	70,800
Vertical Shelter							
Nominal Spacing	2,000	7,500	11,900	7,900	6,700	13,900	14,600
Expanded Spacing	6,800	25,900	41,000	27,300	23,200	47,800	50,500
Slope Sided Pool							
Nominal Spacing	2,600	9,700	15,400	10,200	8,700	17,900	19,000
Expanded Spacing	7,400	28,100	44,300	29,500	25,100	51,700	54,600
Hybrid Trench							
Nominal Spacing	2,700	10,300	16,300	10,800	9,200	19,000	20,100
Expanded Spacing	5,600	21,200	33,500	22,400	19,000	39,100	41,400
Point Security							
Horizontal Shelter							
Nominal Spacing	300	1,200	1,900	1,200	1,000	2,100	2,200
Expanded Spacing	300	1,200	1,900	1,200	1,000	2,100	2,200
Vertical Shelter							
Nominal Spacing	200	900	1,400	900	800	1,600	1,700
Expanded Spacing	200	900	1,400	900	800	1,600	1,700
Slope Sided Pool							
Nominal Spacing	300	1,300	2,000	1,300	1,100	2,300	2,400
Expanded Spacing	300	1,300	2,000	1,300	1,100	2,300	2,400
Hybrid Trench (not appropriate)							

In these cases, jobs provided for local residents will vary with mode, with hybrid trench providing the most local employment (33,000), closely followed by slope-sided pools and horizontal shelters (26,000 and 22,000 respectively). The vertical shelter mode, in each case, provides the lowest level of local employment, with a maximum value of 17,000 jobs for the Luke/Yuma area.

Local government expenditures represents another group of components of economic issues. Without regard for area under consideration some increase in population will result from the project. In the very undeveloped areas this increase will be large both in relative and absolute terms. On the average, about $10 million in local government expenditures will be required by the development and new population spawned by the project. These effects tend to be highest in West Texas, where a combination of high multiplier effect and low existing levels of expenditures influence the outcome. In contrast, the Luke/Yuma area would experience the smallest public expenditure effects. For example, in the case of the hybrid trench,

Table 3-7. Private land required (in mi^2 [km^2]).

BASING MODE CONFIGURATION	CENTRAL NEVADA	CALIFORNIA MOJAVE	LUKE/ YUMA	WHITE SANDS	WEST TEXAS	TEXAS HIGH PLAINS	SOUTH PLATTE
Area Security							
Horizontal Shelter							
Nominal Spacing	100 (260)	100 (260)	1,000 (2,600)	250 (650)	5,800 (15,000)	6,200 (16,000)	6,200 (16,000)
Expanded Spacing	400 (1,000)	200 (510)	3,300 (9,000)	800 (2,000)	18,000 (47,000)	19,100 (45,500)	19,100 (49,500)
Vertical Shelter							
Nominal Spacing	100 (260)	50 (130)	700 (1,800)	200 (510)	3,700 (9,600)	4,000 (10,000)	4,000 (10,000)
Expanded Spacing	300 (800)	100 (260)	2,300 (6,000)	500 (1,300)	12,800 (33,200)	13,700 (35,500)	13,700 (35,500)
Slope-Sided Pool							
Nominal Spacing	100 (260)	500 (1,300)	900 (2,300)	200 (510)	4,800 (12,400)	5,100 (13,200)	5,100 (13,200)
Expanded Spacing	300 (800)	150 (400)	2,500 (6,500)	600 (1,600)	13,900 (36,000)	14,900 (38,600)	14,900 (38,600)
Hybrid Trench							
Nominal Spacing	100 (260)	50 (130)	900 (2,300)	200 (510)	5,100 (13,200)	5,400 (14,000)	5,400 (14,000)
Expanded Spacing	200 (510)	100 (260)	1,900 (5,000)	400 (1,000)	10,500 (27,200)	11,200 (29,000)	11,200 (29,000)
Point Security							
Horizontal Shelter							
Nominal Spacing	6 (16)	4 (40)	49 (130)	11 (29)	268 (695)	285 (740)	285 (740)
Expanded Spacing	6 (16)	4 (40)	49 (130)	11 (29)	268 (695)	285 (740)	285 (740)
Vertical Shelter							
Nominal Spacing	6 (16)	4 (40)	47 (120)	11 (29)	255 (660)	271 (700)	271 (700)
Expanded Spacing	6 (16)	4 (40)	47 (120)	11 (29)	255 (660)	271 (700)	271 (700)
Slope-Sided Pool							
Nominal Spacing	6 (16)	4 (40)	49 (130)	12 (32)	272 (705)	290 (750)	290 (750)
Expanded Spacing	6 (16)	4 (40)	49 (130)	12 (32)	272 (705)	290 (750)	290 (750)

with nominal spacing, the Luke/Yuma area would require average local public expenditure increases of less than $2 million per year, whereas the West Texas area would require increases on the order of $30 million per year. Expanded spacing increases expenditure requirements from 20 to 50 percent for the area security configuration, reflecting slightly higher direct labor requirements, and very little for point security.

Land required by the project will displace current economic activity. As noted above, total land requirements vary enormously, particularly when security alternatives are considered. Current agricultural production from these lands varies from $90,000 per mi^2 ($34,700 per km^2) in the Texas-New Mexico High Plains to $200 per mi^2 ($80 per km^2) in the Great Basin. The horizontal shelter with expanded spacing in the High Plains could displace $1.7 billion in agricultural production per year. Ranges of possible agricultural losses per year are:

Horizontal Shelter

Nominal Spacing	$1.2 million - $535 million
Expanded Spacing	$3.8 million - $1.7 billion

Vertical Shelter	
Nominal Spacing	\$800,000 - \$343 million
Expanded Spacing	\$2.7 million - \$1.2 billion
Slope-sided Pool	
Nominal Spacing	\$1 million - \$444 million
Expanded Spacing	\$3 million - \$1.3 billion
Inline Hybrid Trench	
Nominal Spacing	\$1.1 million - \$470 million
Expanded Spacing	\$2.2 million - \$970 million

Point security could reduce the maximum loss of agricultural production to no more than $25 million even in very productive areas.

The potential loss of mining revenues due to fencing is highly variable. Two basin and range areas experience the maximum effect: In Central Nevada and California Mojave, deployment of horizontal shelters with area security and either spacing would result in a loss of $74 million. Deployment of slope-sided pools with area security and expanded spacing would eliminate $57 million. Both areas are surrounded by mountains having rich mineral deposits that would be cut off from further mineral extraction activities. In contrast, the South Platte and Texas-New Mexico High Plains areas consist of deep alluvial soils with little mineral content of interest to mining developers.

Local Government Issues (3.2.12)

All modes require a total labor force (direct and indirect) exceeding the capacity of each potential siting area, thus requiring the importation of workers. The importation requirement is so large that it will create potential growth rates over 15 percent a year, outstripping the ability of local government to supply necessary services and facilities unless very careful preplanning occurs. Construction impacts vary considerably with basing mode and spacing. It is assumed that 75 percent of the direct labor force will be housed in construction camps onsite.

In the Luke/Yuma area, the large existing local work force could supply much of the project's construction requirement, in the case of vertical shelters with nominal spacing, for example, about 11,000 additional people would be needed. On the other hand, deployment of hybrid trenches with expanded spacing in the West Texas-Rio Grande BMCA would require the relocation of 109,000 people to the area during the construction phase. In the same area, labor requirements for basing mode construction with nominal spacing would vary with mode to produce total in-migration as follows:

Horizontal Shelter	50,000
Vertical Shelter	37,000
Slope-sided Pool	63,000
Inline Hybrid Trench	86,000

Expanded spacing would increase these requirements for shelters an average of 15 percent and for trenches, about 25 percent.

Local governments will find it necessary to expand public facilities and services to meet the new demand resulting from this growth. Property values will increase to offset some revenue requirements but lag will produce revenue shortfalls for a period of time. In addition, if area security is selected, large land areas will be removed from local tax rolls, producing a net decline in revenues in addition to the increased demand for expenditures. Impacts on local government expenditures will range from less than $1.0 million per year for the vertical shelter mode in Luke/Yuma to about $28.0 million per year for hybrid trench mode in the West Texas-Rio Grande BMCA, if nominal spacing is assumed. For expanded spacing, the impacts will increase from 14 to 52 percent in the same areas.

During the construction phase, new housing will be required in Central Nevada and South Platte BMCAs. Severe shortages will be felt in Central Nevada when slope-sided pool or hybrid trench mode are considered. Hybrid trench mode with expanded spacing will also create appreciable shortages in the South Platte BMCA. These estimates assume that at least 75 percent of the direct labor force live onsite in construction camps and that use of local labor sources is maximized to reduce the need for new housing.

Direct labor during operations will involve a different group of people than during construction but the indirect operations group will be substantially the same. Local governments will thus experience a large turnover in the citizenry to be served. Under area security, operations personnel (and thus the indirect labor supply as well) will be substantially less than during construction (in the range of 25 to 30 percent of the total). Under point security, these figures will increase about 28 percent. In point security, expanded spacing, however, operational direct labor will increase over construction direct labor by 4 to 18 percent.

Local government expenditures in the operations phase will range from a low of $2.1 million per year for the hybrid trench mode in West Texas-Rio Grande BMCA to a high of $4.9 million per year for the slope-sided pool in Central Nevada. Expanded spacing will increase these expenditures by 35 percent in the hybrid trench mode to more than

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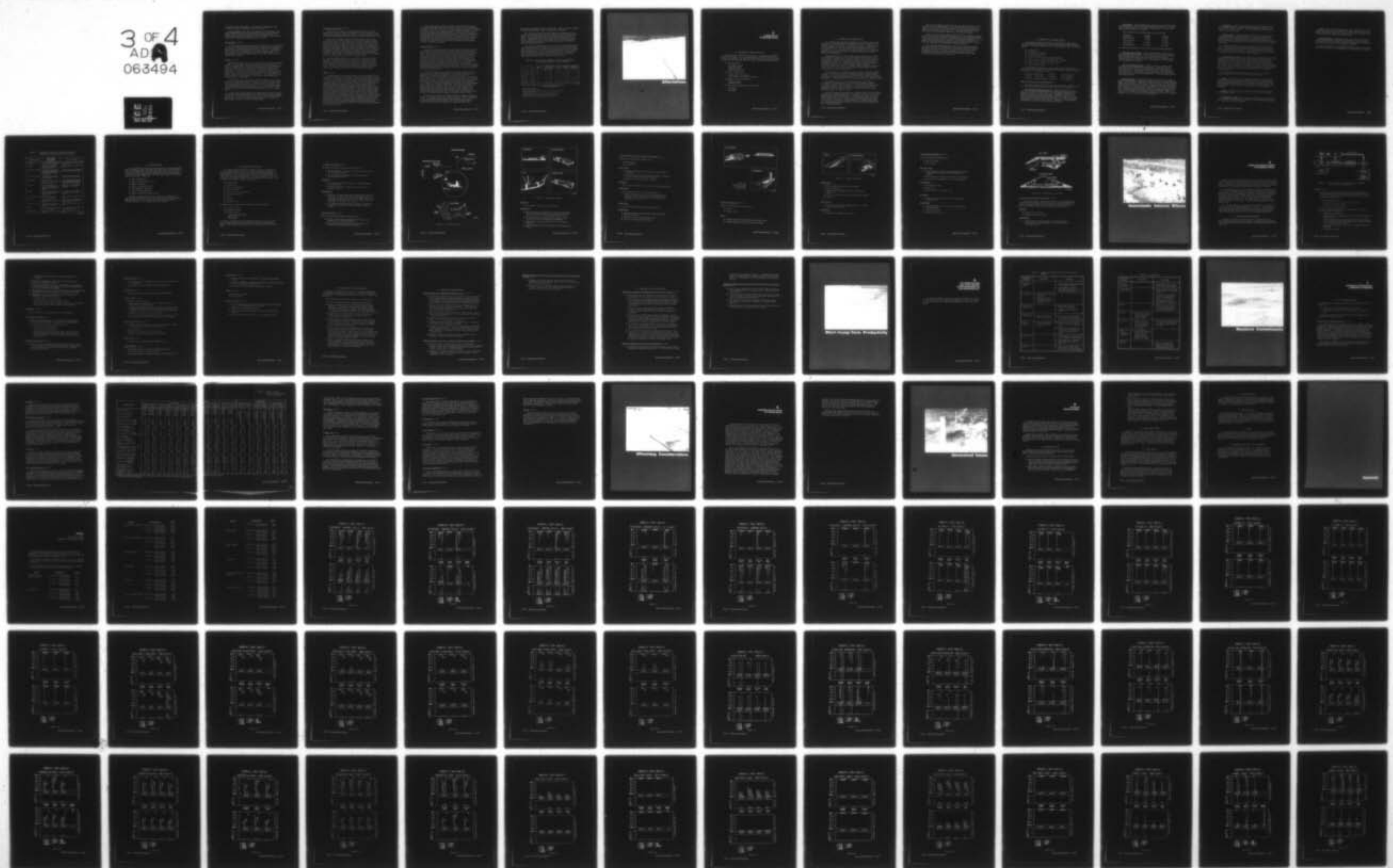

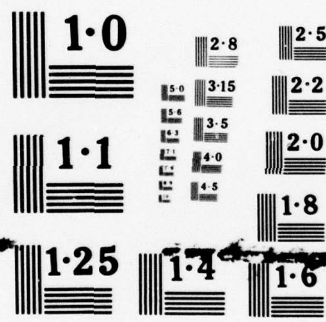
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100 percent in all other modes. Point security configuration also increases the public expenditure by about 28 percent.

Housing impacts in the operations phase will be maximized in the Central Nevada BMCA and will range from moderate in the hybrid trench mode to large in the slope-sided pool mode. Expanded spacing will significantly increase this shortage in Central Nevada. Point security impacts will increase the impacts by about 30 percent.

Public Safety (3.2.13)

Area security affords an advantage over point security in that interaction of the public with missiles and their transporters is reduced with area security. Expanded spacing increases the size of the deployment region and thereby the magnitude of the impact potential. Impact potential is greatest in the Luke/Yuma and California Mojave BMCAs. The West Texas-Rio Grande and Texas/New Mexico High Plains exhibit the next highest impact potential.

Airways (3.2.14)

Specific requirements for control of overflight are subject to change in FSED. However, based on present assessments, restrictions on area security are anticipated. Altitude restrictions currently assumed applicable to the area security configuration would affect airways in the vicinity of the site; point security would allow overflights of the basing area. The effect of the project on airways is greatest for horizontal shelter, area security, expanded spacing, which would involve airways over an area of 19,000 mi^2 (49,500 km^2). The least effect would be incurred with vertical shelter, area security, nominal spacing involving 4,000 mi^2 (10,400 km^2).

Of the basing areas considered, California Mojave has the greatest potential for impact on airways. This area lies within the main transportation link between Los Angeles and major cities to the east. Military traffic would be heavily affected as well, because numerous training, developmental, and operational bases are in or near this corridor. Impacts in the vicinity of Luke/Yuma would be similar but on a smaller scale.

The West Texas, Central Nevada, and White Sands areas are situated away from major transcontinental routes, and mileages of airways affected are smaller. The vertical shelter, area security, with nominal spacing affects 146 mi (234 km) of airways in West Texas, 142 mi (227 km) in White Sands, and 87 mi (139 km) in Central Nevada.

Archaeological Resources (3.2.15)

The magnitude of impact on archaeological resources is highly dependent on the specific areas and extent of surface disruption. Arid areas of low population density are likely to have significantly more preserved archaeological resources than the semi-arid, agricultural areas.

Among the seven BMCAs, impacts on archaeological resources are likely to be large in five, located in the arid west (Central Nevada, California Mojave, Luke/Yuma, White Sands, and West Texas-Rio Grande) and relatively small in Texas-New Mexico Plains and South Platte area. Based on site-specific density, variety and integrity of archaeological resources, preliminary research indicates that White Sands BMCA will have the largest impact and South Platte the smallest. At a given site, archaeological impacts differ among the modes by the amount of surface disturbed. Vertical shelters require the least surface disturbance, with the relative impacts of horizontal shelters being 1.6 times greater, pools 2.0 times greater, and trenches 2.4 times greater.

This intermodal difference is quite marked in the case of Texas-New Mexico Plains BMCA which moves from low to the moderate impact category when hybrid trench mode is considered. However, due to the nature of research conducted at this level the uncertainty involved in the estimates is great, and the impacts may vary from moderate to large. All shelter modes have greater specific aimpoint siting flexibility than trenches and thus have a high mitigation potential.

Cement (3.2.16)

Horizontal shelters, vertical shelters, and slope-sided pools will require about 650,000 to 850,000 tons (590,000 to 770,000 metric tons) of cement. In contrast, the hybrid trench would require about 7.5 million tons (6.8 million metric tons) with nominal spacing and 10 million tons (9 million metric tons) with expanded spacing. These requirements were compared to production capacity over a relatively large supply area around each BMCA and considered in terms of requirements per year. In this framework, the project requirement represents from about 0.3 percent of supply area productive capacity for the vertical shelter mode, to about 4 percent for the hybrid trench. Requirements slightly higher than these average figures would be experienced in the Central Nevada, California Mojave, Luke and White Sands sites, with below average requirement relative to capacity for the two Texas sites. These differences are, however, relatively small, with the percentage range for horizontal shelters being from 0.28 to 0.38 percent. Expanded spacing does not influence the percentage of supply required, with the exception of the hybrid trench; in this case the average requirement increases from 3.6 to 4.9 percent of supply area capacity. No difference exists between area and point security.

Current construction projects throughout the western United States are experiencing cement shortages that have resulted in the transporting of supplies from other parts of the country, delays in construction schedules, and higher prices. This situation results from several factors. Several years of dry winters have interfered with the cement industry practice of building stockpiles during the winter months. Further, a postrecession building boom has moved construction activity to near historic highs. These factors are coupled with problems in the industry itself, largely stemming from many years of excess capacity and the need to invest in new plant and equipment—partly to reduce production costs and partly to meet environmental standards.

Electrical Energy (3.2.17)

During the construction phase, electric power requirements for horizontal shelter, vertical shelter, and slope-sided pool are each about 42 MW, while trenches require about 60 MW. In addition to direct project power requirements, there are the requirements of the new population induced into the project area during the construction phase. These requirements are highly site specific and for the nominal project, vary from about 5 MW for the vertical shelter mode in the Luke/Yuma area to about 73 MX for the trench mode in the West Texas area. The Luke/Yuma new population power requirements are low because a large project-available population exists in that area already. In West Texas, however, considerable new population will have to move into the area to accommodate the project demands and they will bring with them the need for much more electric power in that area.

The energy demands of the various project modes in each of the candidate sites were then weighed against the projected 1986 population demands and the generating capability of the Regional Electric Reliability Council area in which the candidate site falls. The results of this impact review indicate that, with the exception of the Texas High Plains siting area, the nominal project and new population power requirements are never more than 10.0 percent and generally in the range of 1 to 2 percent of the difference between the highest 1986 projected demand and the 1986 lowest projected capability. This particular instance of greatest impact is the trench mode in the West Texas area (Electric Reliability Council of Texas). The instance of least impact is the vertical shelter mode in Luke/Yuma where the lowest total project-induced power requirements are only 0.6 percent of the highest projected surplus in that area (Western Systems Coordinating Council, 1978).

In the Texas High Plains the lowest projected generating capability in 1986 is 2,535 MW less than the projected demand. However, the nominal project requirements in that area, depending on mode, vary from 2.8 to 5.1 percent of the difference between the projected demand and the highest projected generating capability in 1986 (Southwest Power

Pool Electric Reliability Council, DOE, 1978). Table 3-8 shows a summary of project-related power supply and demand for each BMCA.

The analysis indicates that ample power may be available to the project on a regional basis, with the possible exception of Texas High Plains. The regions analyzed are very large and local variation is likely. Future studies will examine the issue of whether it would be better to construct a new plant or expand one or more existing plants than to extend transmission lines from existing sources and whether localized deficits may exist.

It should be understood that uncertainty exists with regard to both power demands and power availability. Projection of 1986 availability assume construction of new plants currently in design stages for example. Such uncertainty will be more specifically addressed in later studies. Such refinement will include the consideration of the alternate use of power presently being used by agriculture especially in irrigated agriculture areas with an area security concept project.

Table 3-8. Nominal project summary of electric power demand vs. generating capability, 1986 (gigawatts).

BMCA	RERC[1]	1986 DEMAND IN RERC	1986 GENERATING CAPABILITY IN RERC		1986 POWER SURPLUS RANGE[4]	TOTAL PROJECT INDUCED DEMAND RANGE[5]	PROJECT DEMAND AS A PERCENT OF POWER SURPLUS RANGE[6]
			MINIMUM (NRC[2])	MAXIMUM (NERC[3])			
Central Nevada	WSCC	120.3	127.3	139.8	7.0 - 19.5	.110 - .197	1.0 - 2.8
California Mojave	WSCC	120.3	127.3	139.8	7.0 - 19.5	.077 - .118	0.6 - 1.7
Luke/Yuma	WSCC	120.3	127.3	139.8	7.0 - 19.5	.076 - .115	0.6 - 1.6
White Sands	WSCC	120.3	127.3	139.8	7.0 - 19.5	.104 - .179	0.9 - 2.6
West Texas	ERCOT	50.7	52.9	53.8	2.2 - 3.1	.121 - .219	7.1 - 10.0
Texas High Plains	SPP	72.9	70.4	76.8	-2.5 - 3.9	.110 - .197	(deficit)[7] - 5.1
South Platte	WSCC	120.3	127.3	139.8	7.0 - 19.5	.110 - .197	1.0 - 2.8

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[1]Regional Electric Reliability Council Area: WSCC - Western Systems Coordinating Council
ERCOT - Electric Reliability Council of Texas
SPP - Southwest Power Pool

[2]Nuclear Regulatory Commission

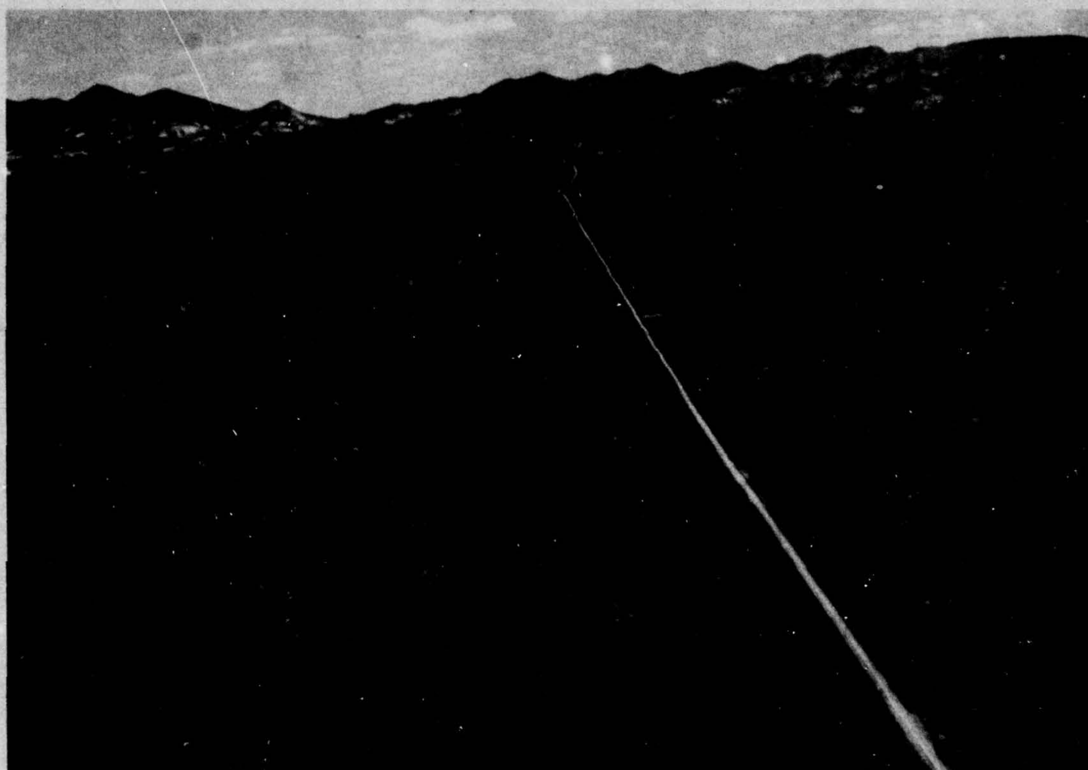
[3]National Electric Reliability Council

[4]Difference between projected capability and demand. Projections assume construction of new plants in design stages.

[5]Varies with deployment mode, security concept, and labor available in region.

[6]Maximum project demand ÷ projected minimum and maximum surpluses in RERCs.

[7]1986 demand exceeds the minimum generating capability in this region.



Alternatives

4
ALTERNATIVES TO THE PROPOSED ACTION

4.1 ALTERNATIVES COVERED IN SECTION 3

The basing mode evaluation study is not a conventional environmental impact study. Rather, it is an environmentally oriented comparison of various alternatives. Thus many alternatives have already been considered in Section 3 "Environmental Impacts." Those considered in Section 3 are:

- Mode Alternatives
  - Horizontal Shelter
  - Vertical Shelter
  - Slope-Sided Pool
  - Inline Hybrid Trench
- Security Alternatives
  - Area Security (all modes)
  - Point Security (all modes but trench)
- Aimpoint Spacing Alternatives
  - Nominal spacing
  - Expanded spacing
- Force Level Alternatives (in one region)
  - Full force
  - 2/3 force
  - 1/3 force

4.2 MINUTEMAN III—SOUTHWEST BASING

As a hedge against increasing vulnerability of ICBMs in fixed (silo) deployment, interim deployment of Minuteman III (MM III) missiles in the multiple aimpoint mode is being considered as an option. These missiles would be deployed in facilities suitable for subsequent MX basing, i.e., the aimpoints, roads, and other system elements would be sized for MX compatibility, so that they would not require modification or replacement when MX was subsequently deployed. Current planning is for vertical shelters, point security.

The minimum-cost option would involve making maximum use of as much MX equipment as possible, so that minimum modification of MM III operational support equipment (OSE) would be required. MM III equipment would consequently not have to be installed and subsequently replaced by MX-compatible equipment. This approach would, however, require accelerated development and production of MX-compatible ground, mechanical, and electrical equipment to support the planned Initial Operational Capability (IOC) of MM III. This accelerated MX-related activity would increase near-term, but decrease overall costs.

The costs unique to the MM III would be those associated with modifications of the missile, the missile/canister interface, the missile/OSE interface, and the associated ground and flight tests. The MM III would be modified to the minimum feasible extent to permit horizontal transport and cold launch. Risks consistent with a five-year service life would be accepted.

The minimum early-year (FY 1980-1984) funding option would use existing MM III ground mechanical and electrical equipment, modified for multiple aimpoint (MAP) deployment. The MX missile and ground system development schedule would be unaffected. This option would reduce early-year costs, but increase total costs because much of the interim hardware would not be useful with MX.

The MM III deployment rate would be 5 missiles/month, with 10 shelters/missile, with a nominal deployment of 180 missiles. This is a rate of 600 aimpoints/year, and takes three years. Minuteman will remain in service while subsequent MX's are deployed. (Projected modified MM III nominal service life is five years). MX deployment can be assumed to be at the rate currently established as nominal (five-year total deployment) until all required aimpoints are constructed; MM III would then be replaced by MX to complete deployment.

The principal changes from MX issues will be those associated with the construction rate (aimpoints/year). The construction period will be extended, and over part of the period will be at less than the nominal rate previously assumed for vertical shelters. This would produce an initial period with less socioeconomic impact than the normal MX program.

Adoption of the Interim Southwest Basing option as currently visualized could also potentially (though not necessarily) foreclose other basing-mode options because of the sunk costs and established project momentum. (Applies if more than one mode carried into FSED.) This factor would likely be stronger if the "minimum cost" option involving early development, production, and deployment of MX-compatible assets were adopted.

Since the Interim Southwest Basing option would become MX vertical shelter basing after the interim period, the impact potentials would be the same as vertical shelter impacts in whichever security and spacing configuration is used. Similarly, Minuteman III could be based in alternative basing modes. In this case, environmental impacts would be similar to those described in Section 3.

4.3 MINUTEMAN III MAP NORTHERN BASING

A Minuteman III MAP force presumed to be deployed in North Dakota, Colorado, Nebraska and Kansas has been analyzed by the process described in Section 3.1 Analysis Technique. The system parameters used for analysis were:

- 550 missiles
- 20 aimpoints per missile
- 11,000 total aimpoints
- 7,000 ft (2,100 m) spacing between aimpoints
- 1,570 ft (500 m) safety zone around each aimpoint
- 720 ft (220 m) setback from public roads
- vertical shelter basing

The environment against which these parameters were analyzed was determined by the distribution of missiles and aimpoints among the present MM III Wings. This distribution was:

• Wing III	(Minot AFB)	175 MM III	3,500 aimpoints
• Wing V	(Warren AFB)	200 MM III	4,000 aimpoints
• Wing VI	(Grand Forks AFB)	175 MM III	3,500 aimpoints

<u>Impact of the Project on the Environment</u>.

The impacts associated with Northern Basing have been summarized into the same 13 environmental concerns discussed for other excursions.

<u>Interference with Important Species</u>. Impact potentials are quite small for all three Minuteman wings. Few endangered, threatened or rare species are present in these areas. The large mammals present (deer, antelope, coyotes) have been accustomed to coexistence with humans in this region and would not be particularly sensitive to impacts. A small number of state protected fishes may be present in or near the wings but little impact to regional water supplies is expected to result from MX deployment so the threat to these species is minimal.

Air Quality. Present ambient dust levels in the areas average about 40 $\mu g/m^3$ and the project is expected to raise these levels 7 to 14 $\mu g/m^3$ during construction and 3 to 12 $\mu g/m^3$ during operation. This is well below statutory limits of 150 $\mu g/m^3$.

Vehicle emissions may change ambient levels as follows:

Pollutants	Ambient	Project
Nitrogen Oxide	6 $\mu g/m^3$	50 $\mu g/m^3$
Sulfur Dioxide	6 $\mu g/m^3$	10 $\mu g/m^3$
Hydrocarbons	65 $\mu g/m^3$	70 $\mu g/m^3$
Carbon Monoxide	0.2 $\mu g/m^3$	0.2 $\mu g/m^3$

All these vehicle emission levels are well below statutory standards.

Water Quality and Supply. Minot and Grand Forks areas would each require about 2,800 acre feet (3.4 million m^3) per year while the Warren area would need about 3,100 acre feet (3.8 million m^3) per year due to slightly more aimpoints. All three areas are projected to have adequate supplies to meet these needs. Water quality is not expected to be impacted by the project.

Loss of Recreational Access. There is little or no public land which would be used for MAP MM III deployment. Therefore, the only interference with access to recreational facilities would be due to traffic increases. Construction could add 9,000 to 11,000 vehicles to the traffic in each area in peak hours and operation could add 8,000 to 12,000 vehicles in each area during peak hours. This could cause serious congestion problems.

Natural Resources. Conservation issues are very similar in these areas and are not major constraints to MAP deployment in existing Minuteman Wings. The potential for impacts to existing air quality and the generally abundant water supplies is very small. Siting in agricultural areas mitigates potential for disruption of natural vegetation and wildlife habitats while reducing agricultural output in proportion to the size of the fenced area. Aesthetic impacts and habitat loss will be small and appear to be typical for the point security concept in the Great Plains. Only 15 to 23 mi^2 (39 to 65 km^2) of natural habitat and 60 to 100 mi^2 (155 to 260 km^2) vegetative cover in each region will be disturbed.

Land Rights. Point security allows siting of individual aimpoints to be flexible enough to avoid displacing inhabitants. However, 30 to 35 mi^2 (78 to 91 km^2) of private land in each area will be needed for aimpoints and access roads.

Economic Issues. Labor requirements of construction and operation could be as high as 21,000 direct jobs. This will far outstrip the approximately 4,000 available workers in the immediate project areas. Even considering the surrounding economic effects provinces (EEPs) there is likely to be a labor shortage. This could drive wages up and ruin marginal businesses.

Agricultural production lost will be about $160,000 per year near Minot, $460,000 per year near Warren, and $280,000 per year near Grand Forks. These amounts are much less than the year-to-year fluctuations of the areas not of serious impact. Mining losses are very small relative to regional values—$70,000 per year near Grand Forks.

Local Government Issues. Large numbers of new residents and transient laborers will come into the areas to satisfy the large labor demands. Estimates range from 13,000 to 24,000 new permanent residents in each area and 10,000 to 11,000 transients in each area during construction. For operations, the estimates are 15,000 to 26,000 new residents per area and 6,000 to 7,300 transients. The demands for services and social upheaval due to this change will be severe. Public expenditures in each area will raise $12 to $35 million during construction and $16 to $18 million during operations.

New housing required in each area will be 6,000 to 9,000 units during construction and 9,000 to 16,000 during operation.

Safety. Since there will be aimpoints spread over large deployment regions and missile transporters on the public roads all the time, concern may arise about public safety. Some people will object to having their locale made into a nuclear target. Others will worry about traffic accidents which could result in nuclear spills or rocket propellant explosions.

Airways. Airways would not be obstructed by MM III MAP deployment in the northern areas.

Archaeological Resources. In each of the three areas, 120 to 140 mi^2 (310 to 360 km^2) of surface will be disturbed. Some archaeological impact may result but it should be minimal.

Cement. Each of the three areas will require about 130,000 tons of cement each year during the construction period. Under normal circumstances, this would be well within the area capacity; but unusual conditions could result in shortages and high prices.

Electrical Energy. Deployment of the project will require about 85 MW of electricity in the Warren area and about 75 MW in both Minot and Grand Forks. This may require additional generating facilities but projections of capacity into the future are uncertain.

Table 4-1 presents an environmental comparison between the northern MAP MM III system and the southwest MAP MX system presented in Chapter 3.

Table 4-1. Comparison of MAP MM III (northern) and MAP MX (southwestern) vertical shelter point security.

ANTICIPATED CONCERN	MAP MX (SOUTHWEST) VERTICAL SHELTER POINT SECURITY	MAP MM III (NORTHERN)
Important Species	Very little effect unless deployed in an area with water problems.	Little or no effect due to agricultural nature of region
Air Quality	Dust and vehicle emissions well below statutory levels except possibly in California.	Dust and emissions well below statute levels.
Water Quality and Supply	Most areas have adequate supplies of water (two do not) and water rights are legally complicated in many areas. Quality should not be affected.	Areas have adequate water supplies and water quality should not be affected.
Access Loss (Recreation)	Land requirements are small but traffic congestion may be significant in some areas.	No public land is likely to be used, but traffic congestion is predicted.
Natural Resources	Depending upon site selection, desert areas may suffer significant aesthetic, vegetative cover and natural habitat losses.	Due to agricultural nature of regions, "conservation" issues of aesthetic, habitat, vegetative cover, dust, and water issues will not be significant.
Land Rights	Private land required will vary from 0 to 50 mi^2 (130 km^2) for aimpoints and access roads depending on site. Few inhabitants displaced.	About 100 mi (260 km^2) of private land required. Few inhabitants displaced.
Economics	8,500 to 16,500 construction jobs created. Agriculture losses of $10,000 to $4,000,000 per year depending on site.	21,000 construction jobs created. Agriculture losses of about $900,000 pear year.
Local Government Issues	Serious overloading of public services in most locations.	Serious overloading of public services likely.
Safety	Smaller deployment area and less missiles and aimpoints for public interaction.	Roughly twice as large deployment area, number of missiles and aimpoints for public interaction.
Archaeological Issues	Desert areas may require careful siting to avoid archaeological disruption.	Little likelihood of archaeological impact.
Cement	Up to 850,000 tons (750,000 metric tons) of cement required.	Up to 1,900,000 tons (1,700,000 metric tons) of cement required.
Electrical Energy	About 125-150 MW capacity required for project.	About 230 MW capacity required for project.

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4.4 OTHER MISSILES

It is possible to use missiles other than MX in a Multiple Aimpoint (MAP) deployment scheme. The basing mode impacts of a different missile will not be significantly different from those of MX. This is true because MAP basing is only slightly dependent on missile characteristics. In Section 1.1 the parameters of a MAP system which affect the environment were described. These are:

- Type of basing mode
- Type of security (area, point)
- Number of missiles
- Number of aimpoints/missiles
- Total number of aimpoints
- Distance between aimpoints
- Number of aimpoints constructed/year

Preliminary system design has not progressed far enough to tie down the above parameters for the other missiles which might be used in MAP deployment, but it is unlikely that impacts would be widely different from MX as far as Basing Modes are concerned.

4.5 MX ALTERNATIVE CONFIGURATIONS

The basing modes described in the earlier sections were selected as most promising after a review of a number of different candidate basing concepts. Within these concepts, various other alternatives were also examined. These other alternatives were rejected because they either lack necessary survivability in the event of attack, are not cost-effective, or technical problems render them impractical at present. The criteria used to screen candidate concepts were:

- survivability
- reaction time
- land area requirements
- public interfaces
- physical security requirements
- environmental impact
- cost
- schedule
- technical risk

The basing modes considered were grouped into three categories:

- air mobile options
- unprotected options
- protected options
  - surface multiple aimpoint
  - surface line
  - subterranean

Evaluations of alternatives, considered and rejected, follow. In addition, two alternatives for basing mode development were considered: delay of basing mode development and use of existing silos for MX deployment.

Air Mobile Alternatives (4.5.1)

Air mobile alternatives evaluated were (Figure 4-6):

- Use of wide-body jet aircraft to carry and launch one or more air mobile missions
- Use of helicopters-dirigibles or other aircraft in a land-and-launch scenario

Advantages

- Air mobile options have capability of rapid deployment over large areas
- Adversary must detect, locate, and track over large volumes of space

Disadvantages

- Continuous air alert would provide survivability but would be costly: aircraft on the ground would have the same prelaunch survivability as the current bomber force. This would make two of the three legs of the TRIAD potentially vulnerable to the same kind of attack
- Air launched missiles may require dependence on external survivable navigation data inputs to assure adequate accuracy

Unprotected Options (4.5.2)

Unprotected options considered were (Figure 4-7):

- Missile launch vehicles dispersable over roads, rails, waterways or on unprepared surfaces
- Both conventional and air-cushion vehicles were considered for road and off-road transporters

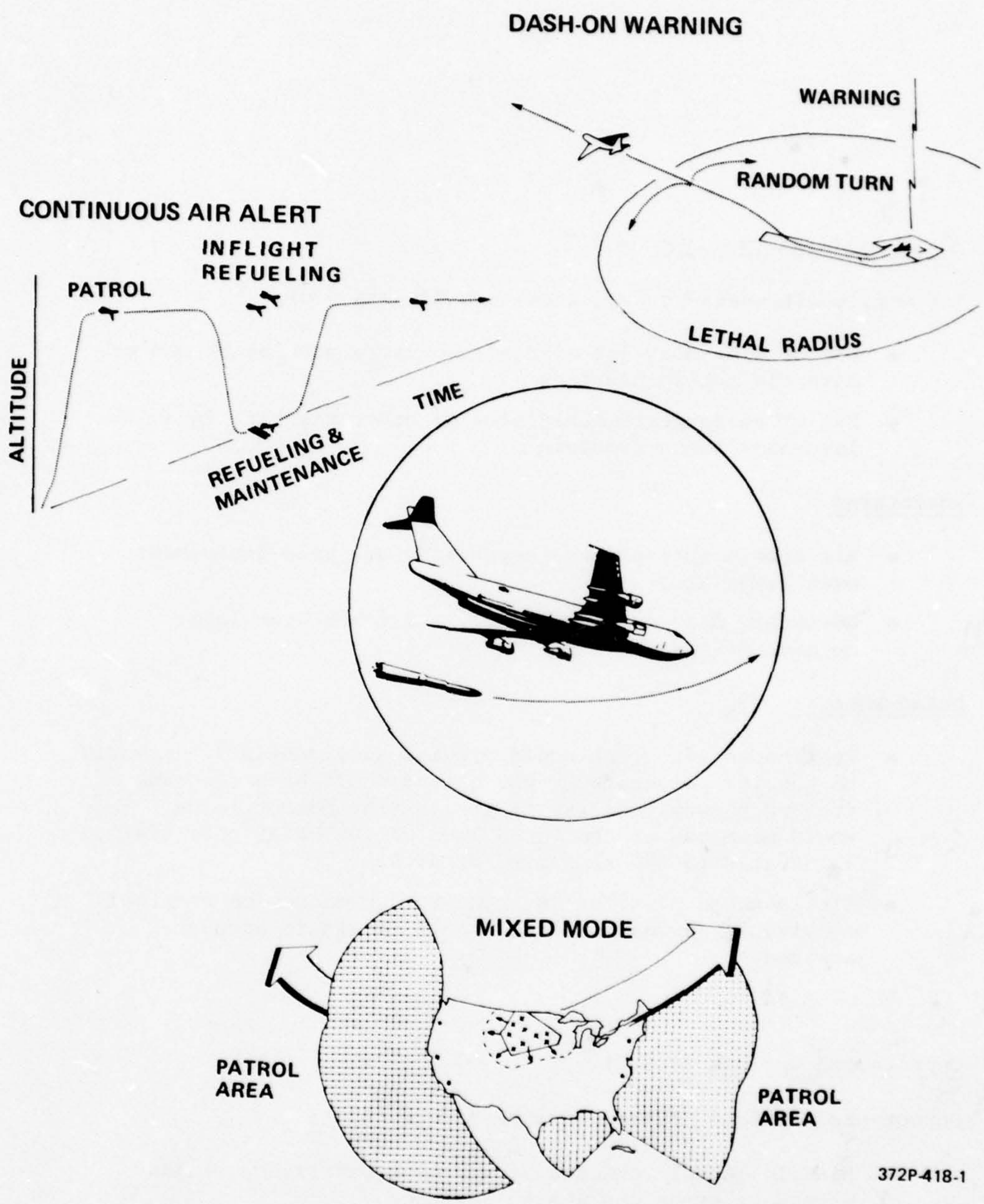


Figure 4-6. Air mobile options.

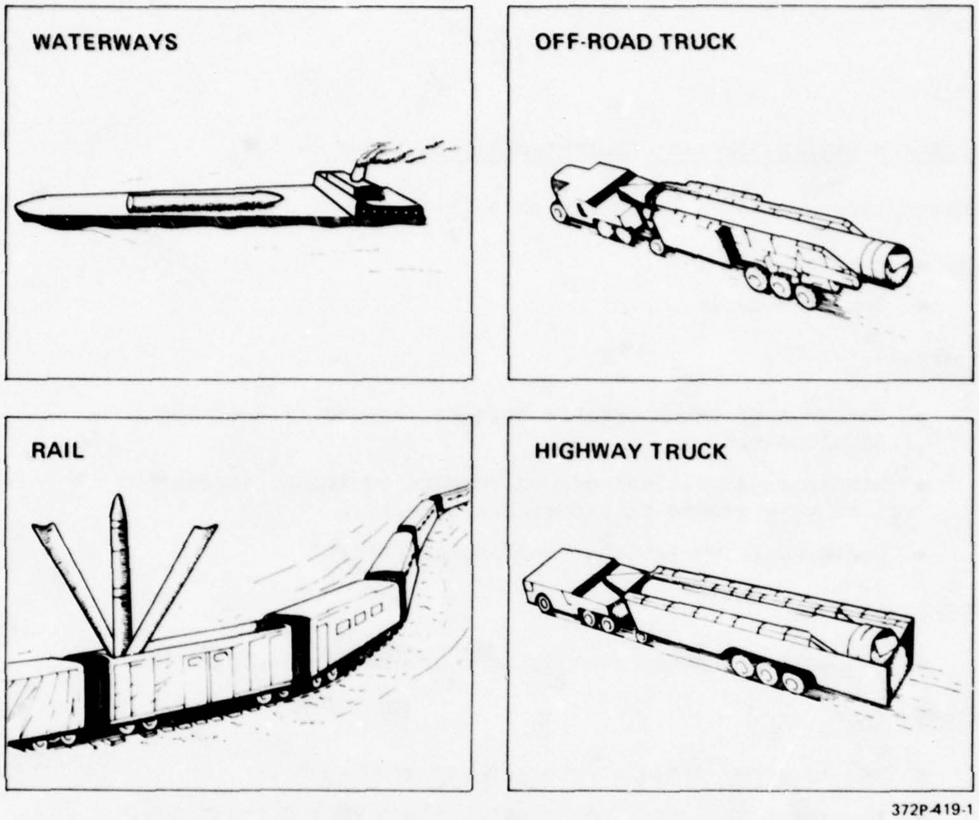


Figure 4-7. Unprotected options.

Advantages

- No expensive "hard" facilities required

Disadvantages

- Launch vehicles are vulnerable to relatively low nuclear weapon overpressures and would require rapid dispersal over large areas to assure adequate survival levels
- Attempts to design increased vehicle hardness failed to significantly reduce dispersal requirements
- Many physical security problems due to direct public interfaces
- Complex command and control problems for widely dispersed missiles

Surface Multiple Aimpoint Protected Alternatives (4.5.3)

Alternatives evaluated were (Figure 4-8):

- Hard capsule
- Revetted rail

Hard Capsule

- Hardness of transportable capsule instead of hardness of aimpoint
- Missile and critical ground support equipment integrated into very rugged transportable structure
- Emplaced in horizontal "coffin" aimpoint

Advantages

- The cost of an aimpoint is reduced, but not substantially

Disadvantages

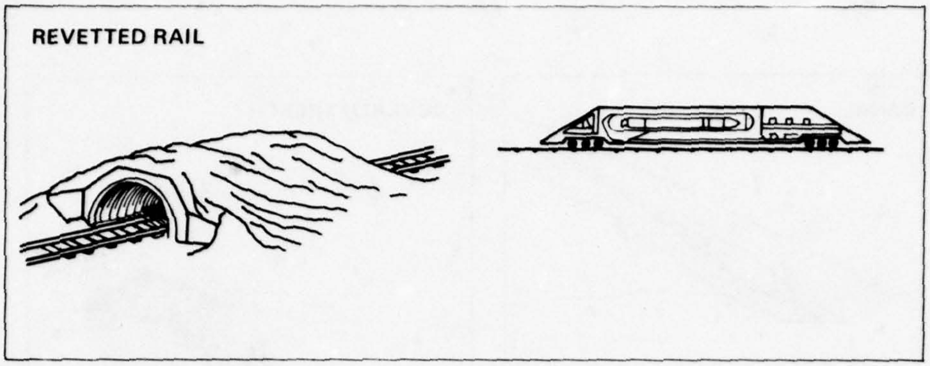
- The hardened capsule is heavy and expensive
- Missile transporter needs specially prepared roads due to weight [over 2 million lb (0.8 million kg) with missile] and size 150 ft long by 25 ft wide by 35 ft high (45 m x 7.5 m x 10 m)

Revetted Rail

- Open-ended shelters connected by rail system

Disadvantages

- Hardness limited by open-ends and limited achievable hardness of missile
- Transport requires large deployment area
- Rails are more expensive than roads



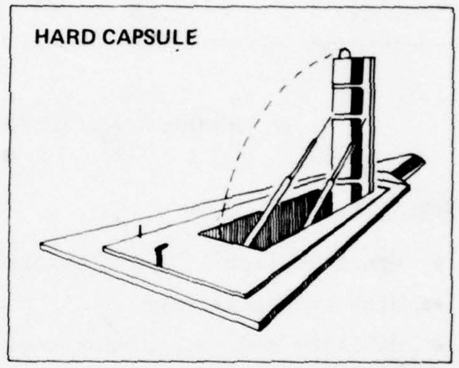


Figure 4-8.
Protected surface
multiple aimpoint
alternatives.

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Surface Alternatives (4.5.4)

Alternatives evaluated were (Figure 4-9):

- Canal
- Covered trench

Canal

- Hardness achieved by submerging missile under water
- Random movement to provide location uncertainty

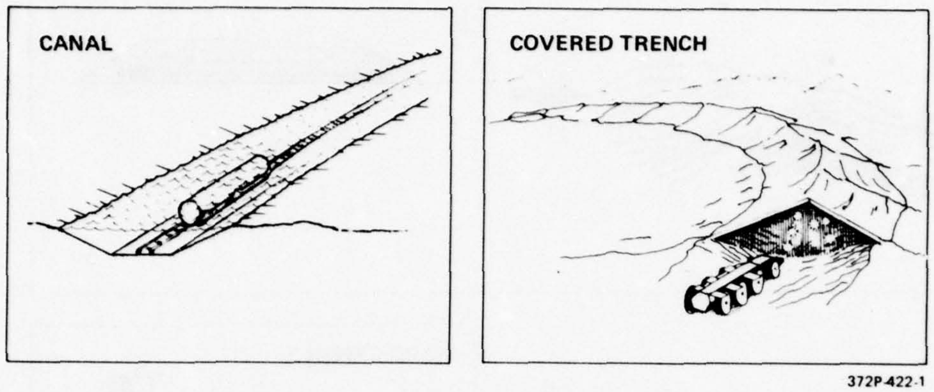


Figure 4-9. Surface alternatives.

Disadvantages

- Water availability and ownership problems
- High technical risk
- Mobility and concealment could be lost with one rupture
- Siting difficulties since canals must follow contours
- High cost

Covered Trench

- Location uncertainty by random movement in a surface trench with a soft cover

Disadvantage

- Vulnerable to moderate attack levels

Subterranean Alternatives (4.5.5)

Options evaluated were (Figure 4-10):

- Hard rock tunnel
- Soil tunnel

Hard Rock Tunnel

- Deep subsurface tunnels in hard competent rock interconnecting a large number of sand-filled launch portals
- Hard portals with "dig-out" mechanism also considered
- Launch vehicle moves missile to a surviving portal

Disadvantages

- Slow reaction times
- High costs
- High technical and schedule risks

Soil Tunnel

- Similar to hard rock tunnel but in soil to reduce tunneling cost

Disadvantages

- Liner needed which resists blast and controls water leakage/drainage
- Slow reaction time
- Technical and cost risks

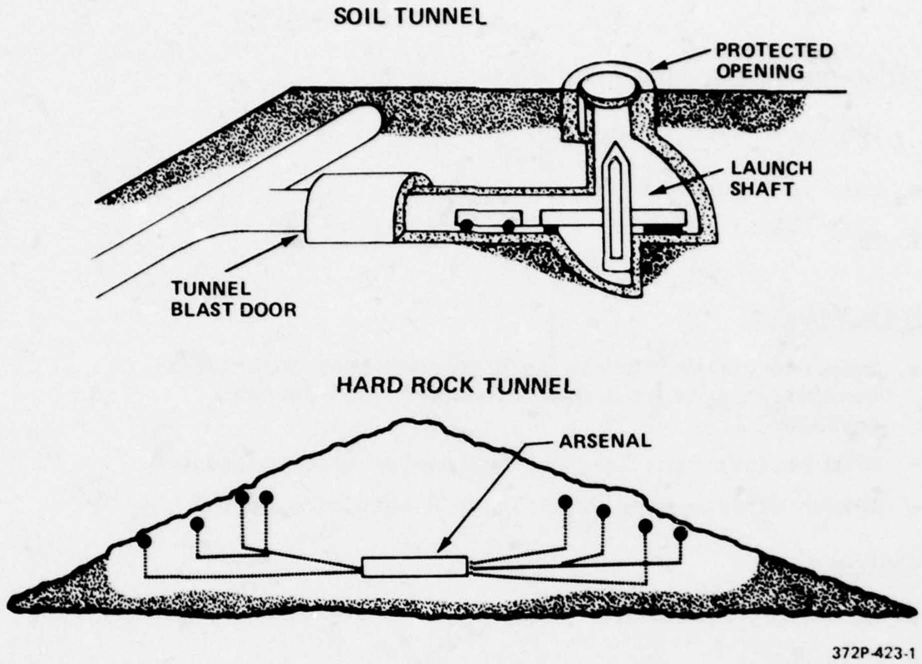


Figure 4-10. Subterranean alternatives.

Use of Existing Silos for MX Deployment (4.5.6)

A new missile having a substantial increase of the Minuteman ICBMs in throw-weight and number of reentry vehicles could partly offset the growth in the Soviet target base and eroding retaliatory capability of our current ICBMs by providing more capability in each missile.

Advantages

- Minimal life cycle cost
- Minimum environmental impact

Disadvantages

- Lack of multiple aimpoints will not assure sufficient survivability, if the requirement is to be able to ride out a major attack.

Unavoidable Adverse Effects

5
PROBABLE UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Chapter 4 identifies the potential direct and indirect effects of the proposed action and alternatives along with the various cumulative environmental consequences. Specific basing modes and their associated security and spacing configurations were analyzed in a parametric manner and the impact potentials of the construction and operation phases were displayed.

The sensitivity function, also displayed, reflects the relative sensitivity of the environmental impact potentials to changes in the project configuration. With the sensitivities identified according to the primary factors and the basic environmental variables, the mitigation measures can be directed toward specific actions which will result in the greatest impact potential reduction. The basic flow diagram for information transfer is shown on Figure 5-1. The variables less sensitive to mitigation efforts would then remain as probable unavoidable adverse environmental effects.

This section addresses the potential methods that can be applied to, reduce or mitigate the impacts identified in Section 3. In addition to alternative specific mitigation measures, this section suggests certain other tradeoffs among the mitigation measures that might be applied to reduce the cumulative impacts of any of the alternative basing modes.

5.1 POTENTIAL MITIGATION MEASURES

Mitigation measures are designed to reduce identified impacts. Those currently identified are listed below. These and other mitigations will be analyzed with their cost, schedule, and performance characteristics during FSED.

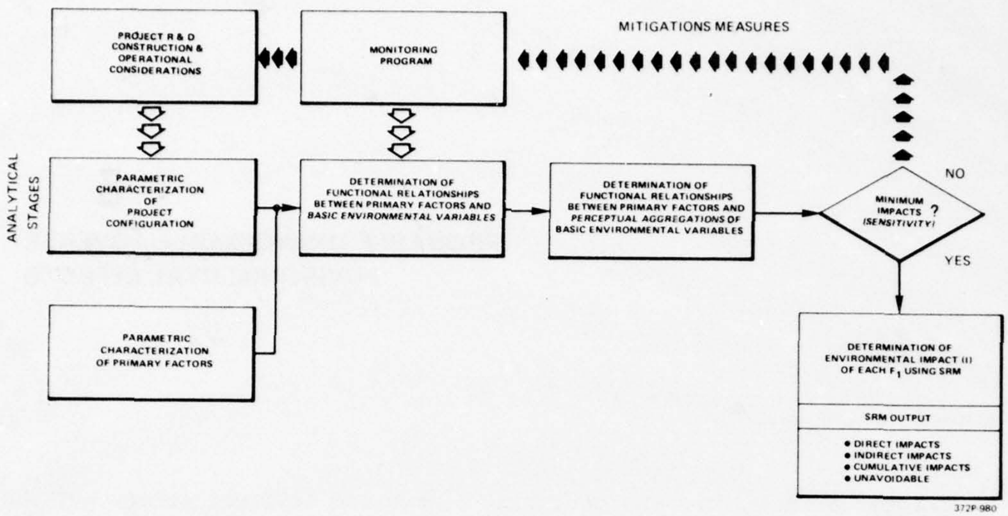


Figure 5-1. Basic flowchart of mitigation measure(s) impact reduction evaluation technique.

<u>Biology</u> (5.1.1)

- The biological impacts of the project can be substantially reduced through site selection and location of facilities within a site to avoid areas of habitat having high biological impact potential, including areas
  - with endangered species
  - heavily used by game or special interest species
  - having slow recovery potential
  - of unique or unusual habitats
- Loss of habitat and vegetation is inevitable for all basing modes but may be reduced by
  - minimizing area disturbed
  - adoption of careful construction practices including placement of borrow sites
  - siting in areas of existing disturbance and low sensitivity (e.g., current or former agricultural land) including existing roads and alignments when feasible
  - confinement of vehicular activities to prescribed roads and alignments
  - replacement of topsoil

- revegetation where feasible, with natural vegetation, if possible

- avoidance of inadvertent or deliberate introduction of non-native plant and animal species
- minimizing fenced areas and use of porous fences where necessary to allow free movement (for migration, feeding, and reproduction) of at least sensitive large mammals.
- consultation with the U.S. Fish and Wildlife Service and appropriate state agencies if species protected by law would be impacted
- Degradation of aquatic habitats as a result of lowering of groundwater levels can be reduced by:
  - minimizing water use in arid areas
  - siting in areas with adequate water supplies
  - monitoring protected aquatic habitats of species in the deployment or water source area to prevent adverse impacts.

<u>Air Quality</u> (5.1.2)

- Using water as a dust suppressant during construction.

<u>Water Supply and Quality</u> (5.1.3)

- Water quality degradation can be minimized by restoration of original drainage patterns and replanting of disturbed areas,
- Possibilities for reduction of water usage are:
  - less water for dust suppression
  - evaporation control for pools
  - splitting the project and distributing it over two or more regions would reduce the strain on water supplies in each individual region (expanded spacing would potentially have similar results)

<u>Recreation (Access Loss)</u> (5.1.4)

- Point security is an important mitigation to land access losses since conjunctive uses, including transportation corridors across sites and access to recreational areas, could be continued throughout the project.

Natural Resources (5.1.5)

- Site selection to accommodate facilities with least impact on surroundings.
- Selection of already disturbed area for deployment.

Land Rights (5.1.6)

- Point security would minimize population displacement.

Economic Issues (5.1.7)

- Slowed construction rate.
- Split basing (regardless of mode: reduces impacts in all BMCAs except Central Nevada).
- Economic Development Administration (EDA) Title IX grants for unemployment compensation, rent and mortgage assistance, job training, relocation of displaced persons and other projects.
- Reduction in project size or split basing.
- Local public school expenditures incurred for children living on the MX support base can be partially federally funded.

Local Government Issues (5.1.8)

- Slowed rate of construction to moderate in-migration, public services funding, and rise in housing costs.
- Split basing.
- EDA Title IX grants (see Economic Issues).
- Federal funding assistance for public schools.

Public Safety (5.1.9)

- Area security minimizes public exposure to risk.

Airways Impeded (5.1.10)

- Minimize control of air space over deployment areas.
- Point security (no controls expected).
- Corridors could be established through the deployment area.

Archaeology (5.1.11)

- Shelter layouts are more flexible in avoiding archaeological sites.
- Prior to construction, perform archaeological surveys and develop data recovery plans as appropriate.
- Site in areas with minimum archaeological resources.

Cement (5.1.12)

- National purchasing
- Split basing

Electrical Energy (5.1.13)

- Missile dormancy would reduce requirement for both missiles and decoys (could save as much as one third).
- Addition of a generating facility.
- Split basing could also mitigate area-related energy supply impacts.
- Adopt renewable energy sources (e.g., geothermal, solar).

5.2 TRADEOFFS AMONG MITIGATIVE MEASURES

Usually in a project of this nature the tradeoffs are between environmental consideration and either cost or project performance. In this case, the environmental mitigations are often in conflict with each other.

Most of the major tradeoffs or conflicts are listed below:

- Cost is a tradeoff for many environmental mitigations.
- Project performance often is affected by major mitigation measures. In this case, either a smaller project in any location (split basing) or a longer construction schedule will decrease environmental impacts. The longer schedule, in particular, may be unacceptable from a performance viewpoint.
- A tradeoff exists between water usage and fugitive dust. Either water the disturbed areas to suppress dust, or conserve water and allow dust.
- Several of the environmental impacts might be decreased by minor adjustments of individual aimpoint location. However, it is likely to be difficult to avoid biologically important spots, archaeological sites, residential areas, and other sensitive elements simultaneously.
- A consideration in the decision between area security and point security will be the relative merits of two respective groups of effects. Point security may have advantages over area security in regard to land acquisition, land rights, land access, economics, and airways. However, area security may reduce water usage, electricity demand, and nuclear accident potential, and archaeological impacts.
- Siting in developed versus undeveloped agricultural areas has its tradeoffs. Using an agricultural area causes less serious biological, archaeological, water usage, and electric energy impacts. In terms of economics, however, siting in undeveloped areas is the more advantageous.

5.3 UNAVOIDABLE ADVERSE EFFECTS

Impacts Common to All Basing Modes (Nominal Project) (5.3.1)

- Disruption of between 118 and 285 square miles (306 and 738 km^2) of the surface by road building, escavation, dumping of excess earth, construction of support facilities, and other activities. This disruption will adversely affect archaeological and biological values, and increase potential for wind and water erosion.
- Permanent aesthetic degradation (by roads, embankments, and borrow pits) of the existing environment. The more disturbed and less accessible the existing environment, the less the potential aesthetic degradation.
- Diversion of large amounts of resources (federal funds, cement, labor, construction machinery) from other potential uses, primarily during construction.
- Depletion of groundwater reserves and lowering of the water table in some of the potential siting areas.
- Creation of a large potential for fugitive dust as a result of earth handling by construction equipment.
- A variety of impacts associated with transportation of personnel and materials to the site. These include degradation of air quality from exhaust emissions, increased traffic congestion and safety hazards, and increased dust where transportation occurs on unpaved roads.
- Potential adverse socioeconomic impacts at deployment sites depending on number of personnel relocated.

Additional Impacts Due to Area Security Configuration (All Modes) (5.3.2)

- Exclusion of public (and possibly large wild and domestic animals as well) from large fenced areas of land, 4,000 to 6,200 mi^2 (10,400 to 16,100 km^2) at nominal spacing and 11,200 to 19,100 mi^2 (29,000 to 49,500 km^2) at expanded spacing.
- Suspension of alternate land uses (farming, recreation, grazing, inhabitation) from this land for life of the project, a time estimated to be 20 to 30 years.

Additional Impacts Due to Point Security Configurations (All Modes Except Trenches) (5.3.3)

- Suspension of certain land uses (those requiring inhabited structures) from large areas of land up to 5,300 mi^2 (13,800 km^2) for the life of the project.
- Exclusion of public (and large animals) from approximately 21 to 40 mi^2 (54 to 104 km^2) with access roads disturbing an additional 90 to 250 mi^2 (233 to 650 km^2).

5.4 COMPARISON OF BASING MODE IMPACTS

Comparisons Independent of Configuration (Area or Point Security)(5.4.1)

- The total surface area disrupted by shelters or pools will be approximately 40 to 80 percent of that disrupted by trenches.
- It is difficult to distinguish between trenches and shelters or pools with respect to permanent aesthetic degradation. Shelters or pools result in less surface disturbance, and in less area of elevated spoils piles, but have many more miles of treated road surface.
- Shelters or pools utilize much smaller amounts of cement (9 to 12 percent of requirements for trenches), but use 22 to 35 times as much asphalt for road surfacing as would trench deployment.
- Construction of shelters would require approximately 60 to 70 percent of the water required for trench construction and would, therefore, minimize impact on groundwater reserves. Construction and operation of pools would require much more water than other modes with most water being required during operation phase.
- The amount of earch handled during construction of shelters or pools would be approximately 15 to 50 percent of that handled during trench construction with proportionately smaller potential for generation of fugitive dust.
- The labor force required for construction of shelters or pools would be 50 to 75 percent of that required for trenches. This combined with the much smaller material requirements would make transportation impacts for shelter or pool construction less than for trench construction. It would also result in less potential for adverse socioeconomic impacts at deployment sites.

Comparisons Related to Area Security Configuration (5.4.2)

- The fenced areas required for vertical shelter, pool and trench deployments at nominal values are 65, 83, and 88 percent of that

required for the horizontal shelter. At expanded spacing, the fenced area requirements for vertical shelter, pool and trench are 71, 77, and 88 percent of that required for the horizontal shelter.

Comparisons Between Area and Point Security Configurations for Shelters or Pool (5.4.3)

- Point security configurations would require complete exclusion from areas equivalent to 1 percent or less of that required for area security.
- Structures would be excluded from similar total areas for point or area security, but point security allows more possibility of avoiding already existing structures.
- Point security will create more contact between the public and vehicles transporting or appearing to transport nuclear materials.
- Point security will have more potential for accidents involving nuclear materials in areas open to the public.

Short-/Long-Term Productivity

6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND LONG-TERM PRODUCTIVITY

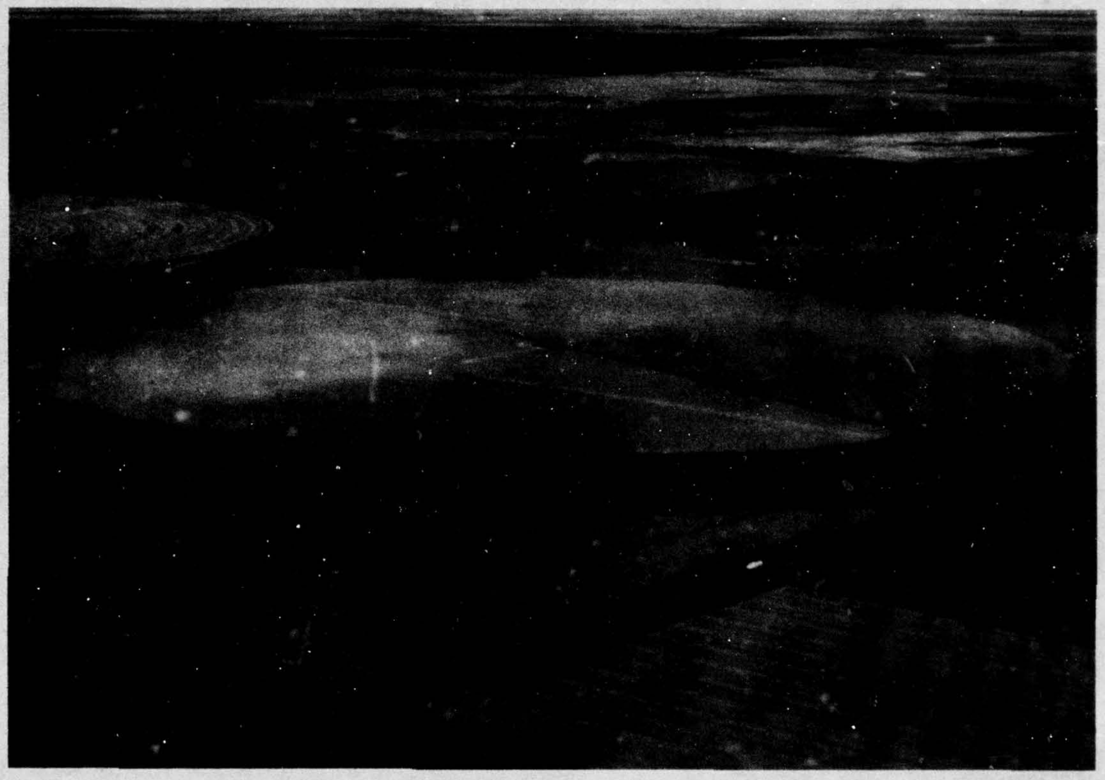
The potential impacts of MX basing modes can be divided into short-term and long-term. These impacts are summarized in Table 6-1. Section 3.2.5 to 3.2.17 present a more detailed discussion of these potential impacts.

Table 6-1. Summary of potential short-term and long-term impacts.

ANTICIPATED CONCERNS	SHORT-TERM	LONG-TERM
Important Species		• Aquatic species may be affected by groundwater lowering • Large mammals may have migration habits disrupted by area security fencing
Air Quality	• Construction dust and emissions • Operation vehicle comissions for point security expanded spacing	
Water Quality and Supply		• Water table lowering possible in some areas • Competition for access to water
Access Loss (recreation)	• Traffic congestion during construction	• In area security large areas of land may lose alternate use potential for 15-25 years
Natural Resources	• View interruptions during construction by dust	• Permanent loss of aesthetic values if sited in unspoiled area • Long term loss of natural habitat and vegetative cover in slow recovering desert areas
Land Rights		• Large amounts of private land may be needed in area security • Large numbers of inhabitants may be displaced in area security
Economics		• Area security could cause large losses in agricultural production and mining revenues

Table 6-1. (Continued).

ANTICIPATED CONCERNS	SHORT-TERM	LONG-TERM
Economics (Continued)		• Labor demands could cause local severe wage inflation
Local Government Issues		• Severe disruption of social structure due to "boom town" effect • Overloading of local public services by inmigrating laborers and dependents • Housing shortages and attendant price inflation
Safety		• Point security will cause concern about accidents involving nuclear materials and rocket propellants
Airways	• Area security would cause inconvenience and some rerouting of air traffic	
Archaeology	• Careful siting of shelters or pools could keep archaeological disruption to a minimum	• Trench mode deployment is not as flexible as shelters and could cause major impact in arid areas
Cement (And Other Construction Materials)	• Large amounts of construction materials will be used but should not cause major impacts on supplies or demands	
Electrical Energy		• Electricity demands may require generation or transmission facilities and accompanying impacts.



Resource Commitments

7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

7.1 LOSS OF NATURAL RESOURCES

The commitments of natural resources to the project fall into two categories.

- Consumption or permanent disposition of resources.
- Alteration or destruction of some resources at the project site.

These categories will be discussed within the framework of the variables used in impact analysis.

Interference with Important Species (7.1.1)

No irreversible impacts are expected to occur. Damage to natural populations is generally reversible as long as sufficient natural habitat remains even though some individual organisms will be destroyed or displaced by disturbance of between about 150 and 300 square miles of surface (Table 7-1). Threatened or endangered species are much more susceptible to disturbance primarily due to their very small population sizes. Federal endangered species legislation and U.S. Air Force regulations require special precautions and consideration of these species to minimize adverse impacts and to prevent jeopardizing the continued existence of their populations.

The severity of impacts of security fencing on large animals vary with basing mode and fencing type. Effects due to fencing can be mitigated during the life of the project.

Air Quality (7.1.2)

Degradation of air quality is expected to be small and generally reversible. Dust and various gaseous pollutants associated with construction will quickly return toward baseline values when construction is completed. Some particulate and gaseous emissions will continue during the life of the project from operations, equipment and activities. Levels will be low and will depend to some extent on basing mode.

Water Quality and Supply (7.1.3)

Any changes in water quality associated with MX deployment are expected to be reversible. Some sedimentation is likely during construction, but should diminish toward baseline values when construction ends. Water use varies with basing mode (Table 7-1) between 7,000 and 46,000 acre-ft (8.6×10^6 and 57×10^6 m^3) per year.

In areas of ample ground water supply and high rates of recharge, the impact of water use will be largely reversible. Ground water use in arid regions where annual evaporation exceeds precipitation is an irreversible impact. In arid regions ground water drawdown represents mining of an essentially non-renewable resource. Aquatic habitats which depend upon ground water for maintenance and which may contain protected species can be permanently impacted by heavy withdrawal. In some areas withdrawal of ground water leads to irreversible land subsidence which can permanently alter the holding capacity of the aquifers as well as altering ground surface uses.

Recreation (7.1.4)

Loss of recreation value due to congestion and access restriction represent irretrievable commitments during construction and operation of the system. Some aspects of construction such as roads and concrete structures will represent irreversible loss in direct proportion to their permanence and the extent to which they reduce the recreational value of the land. The total area potentially lost to recreational use varies with basin of mode and is shown in Table 7-1. Loss of recreational use will be greatest on non-DOD publically owned lands.

Use of Natural Resources (7.1.5)

Use of natural resources represents a largely irreversible commitment. Degradation of the aesthetic value and natural character of the landscape that would result from MX deployment in undisturbed areas will be irreversible, or will extend well beyond the life of the system in most of the BMCAs because of the slow rate of ecosystem recovery characteristic of arid regions. The buried trench mode, because a higher proportion of the

PRIMARY FACTORS*	AREA SECURITY						
	HORIZONTAL SHELTER		VERTICAL SHELTER		SLOPE-SIDED POOL		INLINE HY
	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL
Fenced Area (sq. mi)	6,200	19,000	4,000	14,000	5,000	15,000	5,400
Fenced Area (km^2)	16,000	50,000	10,000	35,000	13,000	38,000	14,000
Deployment Area (sq. mi)	13,000	40,000	8,200	28,000	11,000	31,000	11,000
Deployment Area (km^2)	34,000	100,000	16,000	74,000	28,000	80,000	30,000
Safety Area (sq. mi) (km^2)	0	0	0	0	0	0	0
Surface Area Disturbed (sq. mi)	190	240	120	180	240	290	290
Surface Area Disturbed (km^2)	480	630	310	460	620	760	740
Total Earth Handled (10^6 yd^3)	430	540	190	280	330	480	900
Total Earth Handled (10^6 m^3)	330	410	140	220	250	370	690
Cement (10^6 tons/yr)	0.14	0.14	0.13	0.13	0.17	0.17	1.51
Cement (10^6 metric tons/yr)	0.13	0.13	0.12	0.12	0.16	0.16	1.37
Fly Ash (10^3 tons)	74	74	78	79	84	84	850
Fly Ash (10^3 metric tons)	67	67	71	72	76	76	770
Reinforcing Steel (10^3 tons)	160	160	150	150	86	86	593
Reinforcing Steel (10^3 metric tons)	140	140	130	140	78	78	540
Sand (10^7 tons)	3.3	4.8	2.2	3.4	5.6	7.9	16
Sand (10^7 metric tons)	3.0	4.4	2.0	3.1	5.1	7.2	14
Aggregate (10^7 tons)	4.3	6.4	3.1	4.7	5.9	9.8	3.0
Aggregate (10^7 metric tons)	3.9	5.8	2.8	4.3	5.3	8.9	2.8
Water Construction (10^3 acre-ft)	9.7	11.0	7.0	7.8	45	46	24
Water Construction (10^6 m^3)	12.0	13.0	8.6	9.6	55.0	57.0	29.0
Water-Construction + 10 yr operation (10^3 acre-ft)	28.0	46	23	39	340	360	36
Water-Construction + 10 yr operation (10^6 m^3)	34	57	28	48	420	450	44.0
Liquid Asphalt (10^9 gallons)	0.14	0.21	0.13	0.20	0.20	0.29	0.13
Liquid Asphalt (10^6 m^3)	0.51	0.79	0.49	0.78	0.77	0.11	0.50
Electricity-Construction (MW)	180	180	180	180	200	200	250
Electricity-Operation (MW)	100	130	96	120	110	140	190
Petroleum Fuels (10^7 gal/yr)	2.3	2.8	7.5	2.1	5.0	5.5	14.0
Petroleum Fuels (10^4 m^3/yr)	8.6	11.0	28	7.9	19.0	21.0	54.0
Vehicle Miles (10^6 mi/yr)	9.7	14.0	6.5	9.7	18.0	24.0	18.0
Vehicle Miles (10^6 km/yr)	16.0	23.0	10	16.0	29.0	39.0	29.0
Labor-Construction (10^3)	10.7	12.0	8.5	9.7	13	14	17
Labor-Operation (10^3)	5.0	10.1	4.4	8.9	5.7	12	4.2
Cost-Construction (10^9 \$)	2.7	3.3	2.7	3.2	4.8	5.5	4.2
Disturbed Area Operation (sq. mi)	56	83	43	73	76	100	2
Disturbed Area Operation (km^2)	150	220	110	190	200	270	5

*Estimated values based on present conceptual configurations. Subject to refinement during FSED, and further analysis in subsequent environmental statements.

Table 7-1. Values of primary factors for configurations listed in Table 3-1.

SECURITY				POINT SECURITY					
SLOPE-SIDED POOL		INLINE HYBRID TRENCH		HORIZONTAL SHELTER		VERTICAL SHELTER		SLOPE-SIDED POOL	
NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED	NOMINAL	EXPANDED
5,000 13,000	15,000 38,000	5,400 14,000	11,000 29,000	35 92	35 92	21 54	21 55	40 100	40 100
11,000 28,000	31,000 80,000	11,000 30,000	24,000 61,000	13,000 34,000	40,000 104,000	8,200 21,000	28,000 74,000	11,000 28,000	31,000 80,000
0	0	0	0	4,800 12,000	4,800 12,000	4,600 12,000	4,700 12,000	5,300 14,000	5,300 14,000
240 620	290 760	290 740	400 1,000	190 480	240 630	110 290	160 420	240 620	300 770
330 250	480 370	900 690	1,200 910	430 330	540 410	130 100	210 160	330 250	480 370
0.17 0.16	0.17 0.16	1.51 1.37	1.99 1.81	0.14 0.13	0.14 0.13	0.13 0.12	0.13 0.12	0.17 0.16	0.17 0.16
84 76	84 76	850 770	1,000 900	74 67	74 67	72 66	73 66	84 76	84 76
86 78	86 78	593 540	700 630	160 140	160 140	150 130	150 140	86 78	86 78
5.6 5.1	7.9 7.2	16 14	19 17	3.2 2.9	4.8 4.4	1.7 1.6	2.7 2.5	5.6 5.1	7.9 7.2
5.9 5.3	9.8 8.9	3.0 2.8	3.6 3.3	4.3 3.9	6.5 5.8	2.2 2.0	3.4 3.1	5.9 5.3	9.8 8.9
45 55.0	46 57.0	24 29.0	34.0 42.0	9.7 12.0	11 13.0	9.7 12.0	11 13.0	45 55.0	46 57.0
340 420	360 450	36 44.0	47 58.0	32 30	55 68.0	29 36.0	50 62.0	350 430	370 460
0.20 0.77	0.29 0.11	0.13 0.50	0.14 0.54	0.14 0.51	0.21 0.79	0.9 3.7	0.16 0.62	0.2 0.77	0.3 1.1
200	200	250	300	180	180	180	180	200	200
110	140	190	220	110	140	10	130	120	160
5.0 19.0	5.5 21.0	14.0 54.0	16.0 60.0	2.3 8.7	2.8 11.0	1.6 6.0	1.9 7.4	5.1 19.0	5.5 21.0
18.0 29.0	24.0 39.0	18.0 29.0	20.0 33.0	9.8 16.0	14.0 23.0	6.8 11.0	9.4 15.0	18.0 29.0	24.0 39.0
13	14	17	24	11	12	8.5	9.7	13	14
5.7	12	4.2	5.6	6.4	13	5.6	11	7.3	15
4.8	5.5	4.2	5.0	2.7	3.3	2.5	2.0	4.8	5.5
76 200	100 270	2 5	3 8	72 190	97 250	83 220	130 350	89 230	120 310

ring FSED, and further analysis

2

disturbed area (Table 7-1) can revegetate during the life of the project, represents less of a long term alteration in areas where habitat recovery will occur fairly rapidly. Loss of visibility of broad vistas due to dust concentrations may be a component of aesthetic impacts in some areas but is not expected to persist beyond the construction phase of the project.

Land Rights (7.1.6)

Relocation of people will be an irreversible impact. At the end of the project's useful life a different group of people could reinhabit the project area, but the psychological and sociological impacts on the people relocated cannot be reversed. To a limited extent, these impacts can be mitigated through monetary and other payments but to many people no compensation is possible to completely offset the impacts of moving from traditional family homes and lands, away from friends and neighbors, and into a new pattern of social interactions. Private land acquisition is not reversible at the termination of the project. In certain BMCAs this represents a major consideration due to large amounts of privately held lands.

Economic Issue (7.1.7)

Major commitments of human and economic resources will be made during the life of the project. The use of human resources for construction and operation of the project is considered an irretrievable loss in the sense that it will preclude the personnel from engaging in other productive activities. This is true of both the direct and the indirect and induced effect of the project investment. These are not, however, irreversible commitments since they can be applied to other projects at the end of this project.

Local governments will have to commit their limited resources to meet the needs of the project-induced growth, which will preclude making alternative uses of such resources. The expansion of infrastructure will, to a large extent, be irreversible although some of the facilities could be put to alternative uses once project-induced demand is diminished.

Loss of agricultural revenues due to conversion of such lands to project use will be an irretrievable loss for the life of the project. Part of this loss may even be irreversible if the natural resources on which this activity depends suffer reduced productivity because of the project. Loss of mining revenue may be both reversible and retrievable, provided a partially exploited resource does not suffer degradation during the life of the project.

Local Government Issues (7.1.8)

The importation of several thousand people to an area represents a reversible, but long-term, impact. Provision of various facilities (roads, water and waste water treatment, and housing) is essentially an irretrievable commitment of labor, materials and capital. Provision of services (teachers, policemen, firemen) also involves labor and monitoring expenditures that are irretrievably committed. Revenues lost to local governments because currently taxable land is removed from the tax rolls will irretrievably be lost. This process of loss will be reversible at the end of the project life.

Public Safety (7.1.9)

It is difficult to assess the permanence of people's attitudes toward nuclear accident potential or the perception of being a target. To some extent these concerns are irreversible but allayable.

Airways Impeded (7.1.10)

Restrictions on altitude and patterns of overflight for area security in the project region are probably ireeversible for the life of the project. They may remain irreversible for longer periods because of inertia. Increased fuel use resulting from flying around or above the secured area would represent an irreversible impact on energy resources.

Archaeology (7.1.11)

Destruction of an archaeological site, whether through accident, vandalism, or the best scientific methods currently available is an irreversible, irretrievable impact. This is true because current scientific methods are expected to be less efficient than future (as yet unknown) methods. Thus some significant information that might be available to future researchers will be lost by current methods. At the same time, systematic research on the large scale necessary for the MX project affords a unique opportunity to study spatial distributions of cultures and this remains. The scale of the project also means that in spite of the best available methodology and care, some archaeological sites may inadvertently be lost.

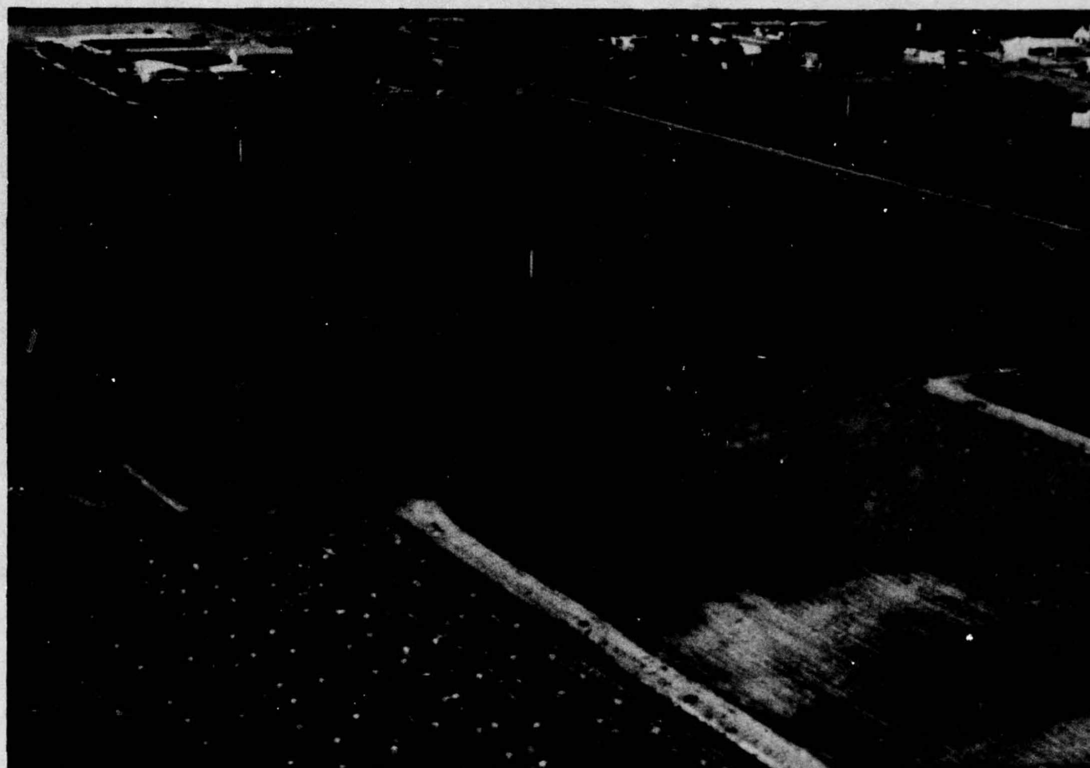
Construction Materials (7.1.12)

Use of construction materials is irreversible. Much if not all of the cement, sand, aggregate, steel and man-hours used cannot be reclaimed. Fossil fuel, electricity and, in areas where fossil groundwater is the major source, water used during construction and operation are irreversible

and irretrievable commitments of resources. Table 7-1 presents amounts of key resources required for construction and maintenance of the various basing mode. The materials that could be recovered after termination of the project depends upon the demand and developed technology at that time but is not expected to be large.

Energy (7.1.13)

The energy used in construction and operation of the MX system represents an irreversible and irretrievable commitment of resources. The amounts of direct sources of energy (fuel and electricity) required for the project are presented in Table 7-1. Electrical energy use is a major resource commitment which varies only slightly with basing mode. Production of the electric energy will require additional materials and energy commitments in the deployment region which will also be irreversible.



Offsetting Considerations

8

CONSIDERATIONS THAT OFFSET THE ADVERSE IMPACTS

Intercontinental ballistic missiles comprise about 80 percent of the strategic forces of the Solviet Union. These forces are in an extensive modernization program with four new ICBM systems under development with three estimated to be under deployment. A fifth generation ICBM is reported to also be under development. Based on the massive upgrading of their ICBM forces supported by the development of the Backfire bomber, now operational and with strategic capabilities, and a submarine-launched ballistic missile being deployed with the capability of destroying targets within the United States from its home port, a large imbalance in military capability will occur. The mid-1980s will, if these Soviet deployment programs continue, bring an endangered strategic stability to the United States and the Free World. It is the national policy that no military imbalance that would endanger the security of this nation should occur or be perceived to occur.

The new USSR ICBMs being deployed are estimated to have up to 10 times as many warheads as the replaced missiles from their strategic inventory, with 4 to 5 times the throw-weight, and a quantum improvement in accuracy. The reliability of the Soviet system to perform its strategic mission will also be greatly upgraded. Not only is the offensive capability of their ICBM forces greatly advanced, but also the land-based forces are being deployed into new super-hardened silos. Two of these systems are reported to be cold launched, thus giving the Soviets additional options for basing their missiles in a more defensibly secure position using deception, concealment, mobility, hardness, and dispersion methods. By the mid-1980s our deployed Minuteman forces will be in jeopardy and unacceptable losses of our deterrent capabilities will occur under Soviet first attack conditions. The USSR and other communist powers are extensively expanding their civil defense programs for population survival, industry, and other commercial/military interests. Expanded, hardened, concealed, and dispersed targeting for the U.S. strategic forces to perform their defense of the nation is a growing

problem. With the FY 1977 budget amendment marking the end of production of ICBMs in the United States, and the leveling of U.S. offensive capability as compared with the USSR growth program, an advanced U.S. ICBM capability is required. With this growing USSR offensive potential, the U.S. strategic systems must be based to give them survivability regardless of the enemy threat.

The Missile X Strategic Weapon System is designed to give the United States ICBM system the necessary capability to survive any Soviet first attack on the United States and still have the offensive capability to destroy required Soviet targets.

Unresolved Issues

9
DETAILS OF UNRESOLVED ISSUES

The Milestone II decisions are expected to result in selection of a basing mode (aimpoint type) (area, point) for development under FSED. (There is an additional possibility that more than one aimpoint/security combination will be carried into competitive evaluation prior to a final selection.) This decision will allow partial resolution of the issues that are basing-mode/security-mode dependent, as discussed in the preceding sections of this FEIS.

Major issues that will remain following this decision are in part independent of the basing system selected, and in part dependent upon the site or sites ultimately selected for deployment. Resolution of these issues will be an important part of FSED, and of the site selection studies.

9.1 LAND-RELATED ISSUES

Regardless of the basing mode selected, the system will either require large fenced areas of land or will require large unfenced areas of land with restrictive easements.

Unresolved issues related to such large uses of land include:

- Public acceptance, particularly under the point-security option, of issues related to perception of safety with respect to accidents (particularly those involving nuclear materials), and the potential of the area becoming a strategic target.
- Where public lands are involved, compatibility of the project with the thrust of the Federal Land Policy and Management Act (Public Law 94-579 of 1976). Under this act, as much public

land as possible is to be opened to multiple uses, including recreational uses as well as grazing, mining, timbering, and defense use.

- Where agricultural lands are involved, compatibility of the project with the requirements of the Council on Environmental Quality (CEQ) Memorandum to Heads of Agencies of 30 August 1976 on the "Analysis of Impacts on Prime and Unique Farmland in Environmental Impact Statements". This Memorandum states in part:

  "Federal agencies should attempt to determine the existence of prime and unique farmlands in the areas of impact analyzed in environmental impact statements prepared in compliance with Section 102(2)(c) of the NEPA (National Environmental Policy Act). This should include threats to the continued use and viability of these farmlands, not only from direct construction activities, but also from urbanization or other changes in land use that might be induced by the federal action."

9.2 WATER-RELATED ISSUES

Regardless of the basing mode selected, large amounts of water will be required for construction and operation. This water must be acquired in both the quantity and quality required for project needs. It must be obtained from surface or subsurface sources in accordance with the requirements of all legal restrictions in the State or States ultimately selected, and extracted in such a way as not to cause environmental degradation (e.g., subsidence, increase in salinity, lowering of the water table sufficient to impact surface-water habitats of threatened aquatic species).

9.3 SOCIAL ISSUES

Construction and operation of the system will attract new workers to the area or areas affected, potentially inducing "boom-town" conditions. The specific mitigations measures that will be applied to minimize the effects of both immigration and real or potential emigration of construction and/or operation personnel cannot be developed in detail at this phase of the program, prior to basing-mode/security-mode selection and comprehensive studies of the ultimate candidate sites. Until that time the nature and scope of these mitigative measures remain an unrestricted issue.

Measures for minimizing the impact on individuals who may be displaced or otherwise influenced by the project (e.g., by loss of local production that supports their businesses) have not yet been identified specifically, and cannot be until site selection. The measures that will be applied and the extent of mitigation possible consequently remain unresolved.

9.4 CULTURAL FACTORS

Archaeological factors in particular are highly site-specific, and cannot be addressed in depth prior to the detailed environmental studies that will precede site selection. The extent of archaeological impacts and of any recovery programs that may be required to preserve archaeological remains is consequently an unresolved issue.

9.5 ELECTRICAL POWER

The intent of the Air Force is to operate the system under normal conditions from commercial power. The analysis performed for this FEIS indicates that additional generation and transmission facilities may be required for this purpose. Whether adequate commercial sources will in fact be available in the selected deployment site (or sites) remains an unresolved issue, as does the resolution of the problem if insufficient commercial sources are available.

9.6 CEMENT

Projections of cement availability in the mid-1980's are currently subject to substantial uncertainty. Although analyses have been performed for this FEIS based on the best available data, the actual impact at the time of construction depends on factors independent of basing mode selections, and cannot be completely resolved at this time.

9.7 INTERFERENCE OF FENCING WITH LARGE MAMMALS

In area security, fencing may restrict the movements of large mammals, resulting in environmental stress. If a barrier fence is determined to be necessary in area security, mitigations consistent with security requirements will be required in some areas. Special fences can provide a warming barrier but remain highly "porous" to large mammals. The extent to which such procedures will be necessary is unresolved.

Appendix

APPENDIX

BAR CHARTS OF IMPACT

POTENTIAL FOR ANTICIPATED CONCERNS

The following figures present the results of potential impact analysis for the 13 anticipated concerns listed in Table 3-3. The development of these charts is presented in Section 3.1 and the results are discussed in Sections 3.2.5 through 3.2.19.

The 480 Basic Environmental Variable Bar Charts which were combined to make up the Anticipated Concern Bar Charts are presented in Appendix B of Volume V.

The arrangement of the Bar Charts in this Appendix is as follows: (Each Figure contains both Nominal and Expanded Spacing).

Concern	Configuration	Figure
Interference with Important Species	Full Force - Area Security	A-1
	- Point Security	A-2
	2/3 Force - Area Security	A-3
	- Point Security	A-4
	1/3 Force - Area Security	A-5
	- Point Security	A-6
Air Quality	Full Force - Area Security	A-7
	- Point Security	A-8
	2/3 Force - Area Security	A-9
	- Point Security	A-10
	1/3 Force - Area Security	A-11
	- Point Security	A-12

Concern	Configuration		Figure
Water Quality & Supply	Full Force	- Area Security	A-13
		- Point Security	A-14
	2/3 Force	- Area Security	A-15
		- Point Security	A-16
	1/3 Force	- Area Security	A-17
		- Point Security	A-18
Access Loss (Recreation)	Full Force	- Area Security	A-19
		- Point Security	A-20
	2/3 Force	- Area Security	A-21
		- Point Security	A-22
	1/3	- Area Security	A-23
		- Point Security	A-24
Natural Resources	Full Force	- Area Security	A-25
		- Point Security	A-26
	2/3 Force	- Area Security	A-27
		- Point Security	A-28
	1/3 Force	- Area Security	A-29
		- Point Security	A-30
Land Rights	Full Force	- Area Security	A-31
		- Point Security	A-32
	2/3 Force	- Area Security	A-33
		- Point Security	A-34
	1/3 Force	- Area Security	A-35
		- Point Security	A-36
Economics	Full Force	- Area Security	A-37
		- Point Security	A-38
	2/3 Force	- Area Security	A-39
		- Point Security	A-40
	1/3 Force	- Area Security	A-41
		- Point Security	A-42
Local Government Issues	Full Force	- Area Security	A-43
		- Point Security	A-44
	2/3 Force	- Area Security	A-45
		- Point Security	A-46

Concern	Configuration	Figure
	1/3 Force - Area Security	A-47
	- Point Security	A-48
Public Safety	Full Force - Area Security	A-49
	- Point Security	A-50
	2/3 Force - Area Security	A-51
	- Point Security	A-52
	1/3 Force - Area Security	A-53
	- Point Security	A-54
Airways Impeded	Full Force - Area Security	A-55
	- Poing Security	A-56
	2/3 Force - Area Security	A-57
	- Point Security	A-58
	1/3 Force - Area Security	A-59
	- Point Security	A-60
Archaeology	Full Force - Area Security	A-61
	- Point Security	A-62
	2/3 Force - Area Security	A-63
	- Point Security	A-64
	1/3 Force - Area Security	A-65
	- Point Security	A-66
Construction Materials (Cement)	Full Force - Area Security	A-67
	- Point Security	A-68
	2/3 Force - Area Security	A-69
	- Point Security	A-70
	1/3 Force - Area Security	A-71
	- Point Security	A-72
Electrical Energy	Full Force - Area Security	A-73
	- Point Security	A-74
	2/3 Force - Area Security	A-75
	- Point Security	A-76
	1/3 Force - Area Security	A-77
	- Point Security	A-78

PARAMETRIC IMPACT ANALYSIS

INTERFERENCE, IMPORTANT SPECIES - AREA SECURITY

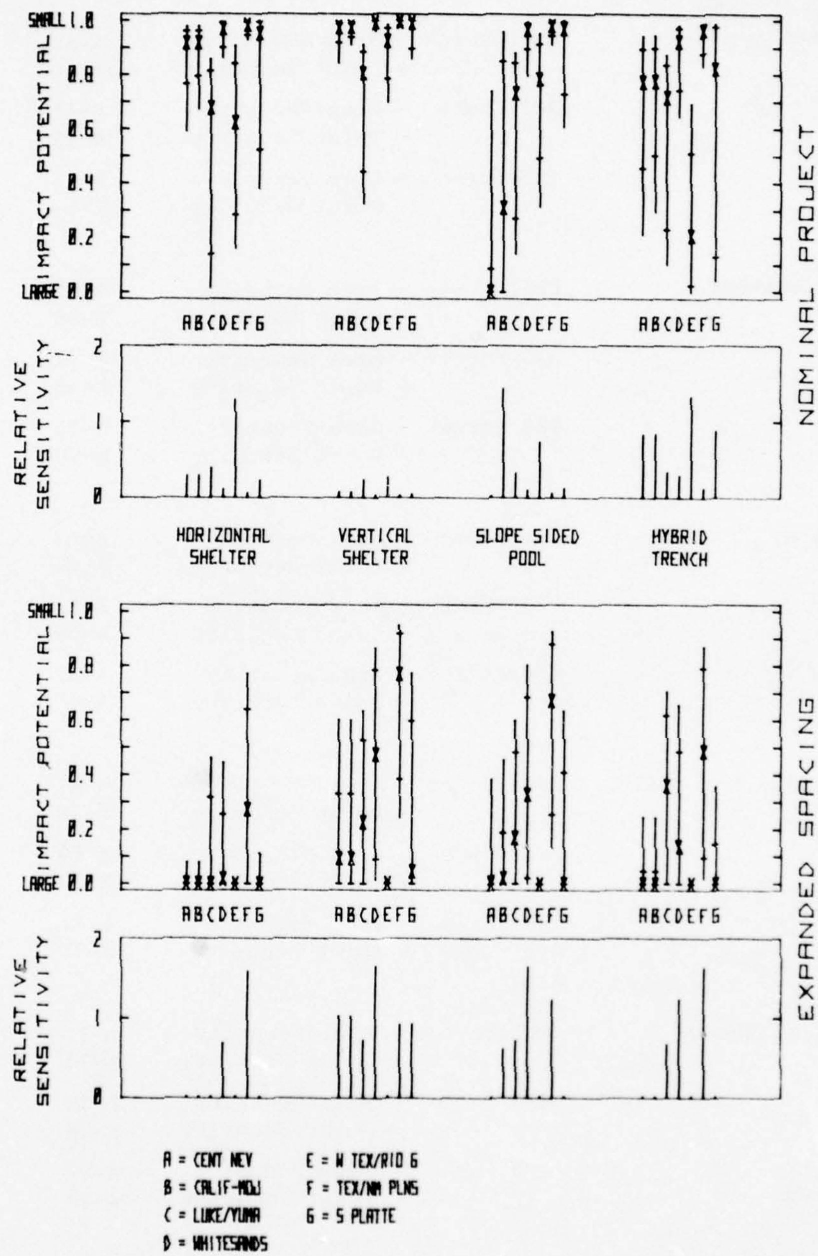
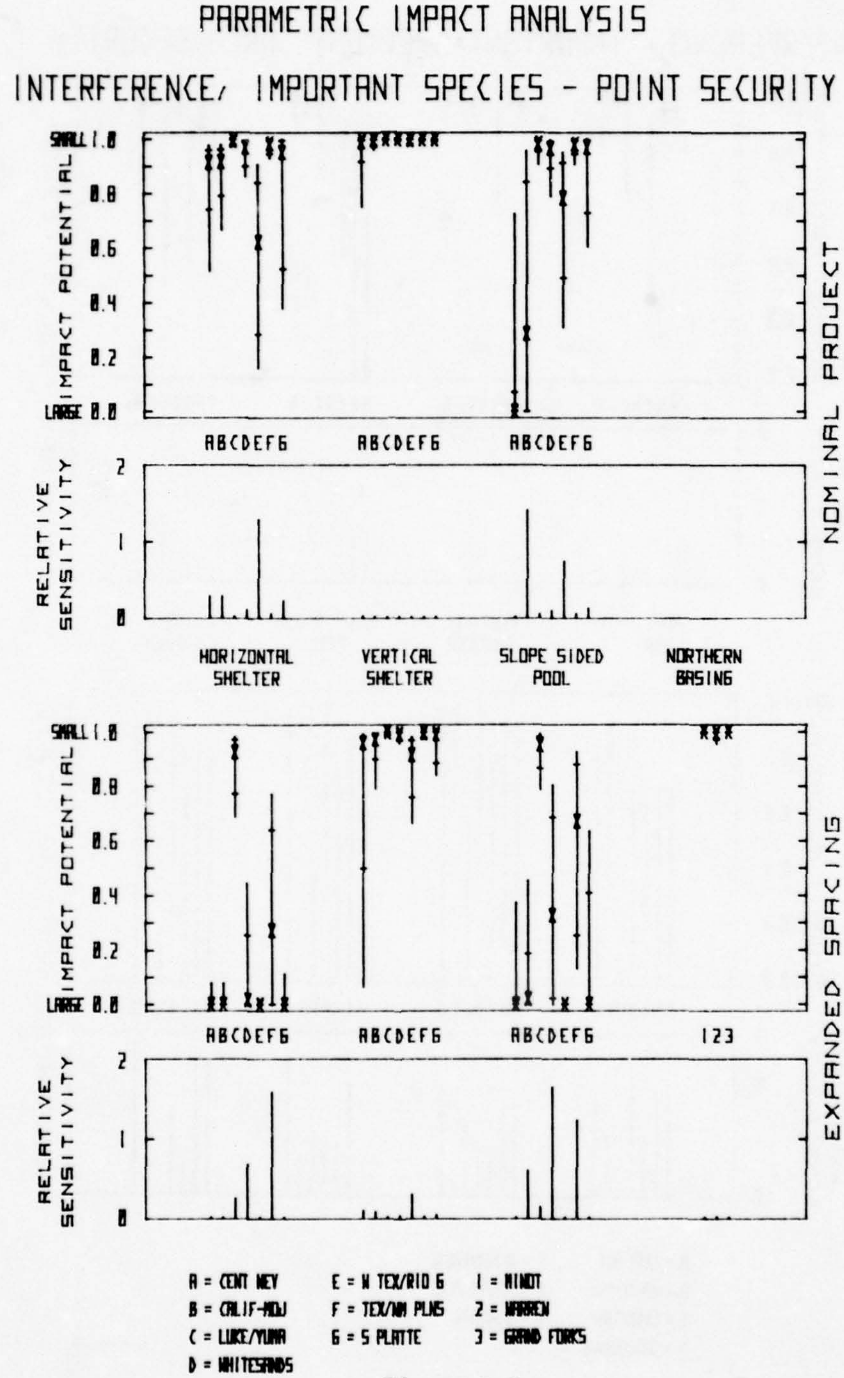
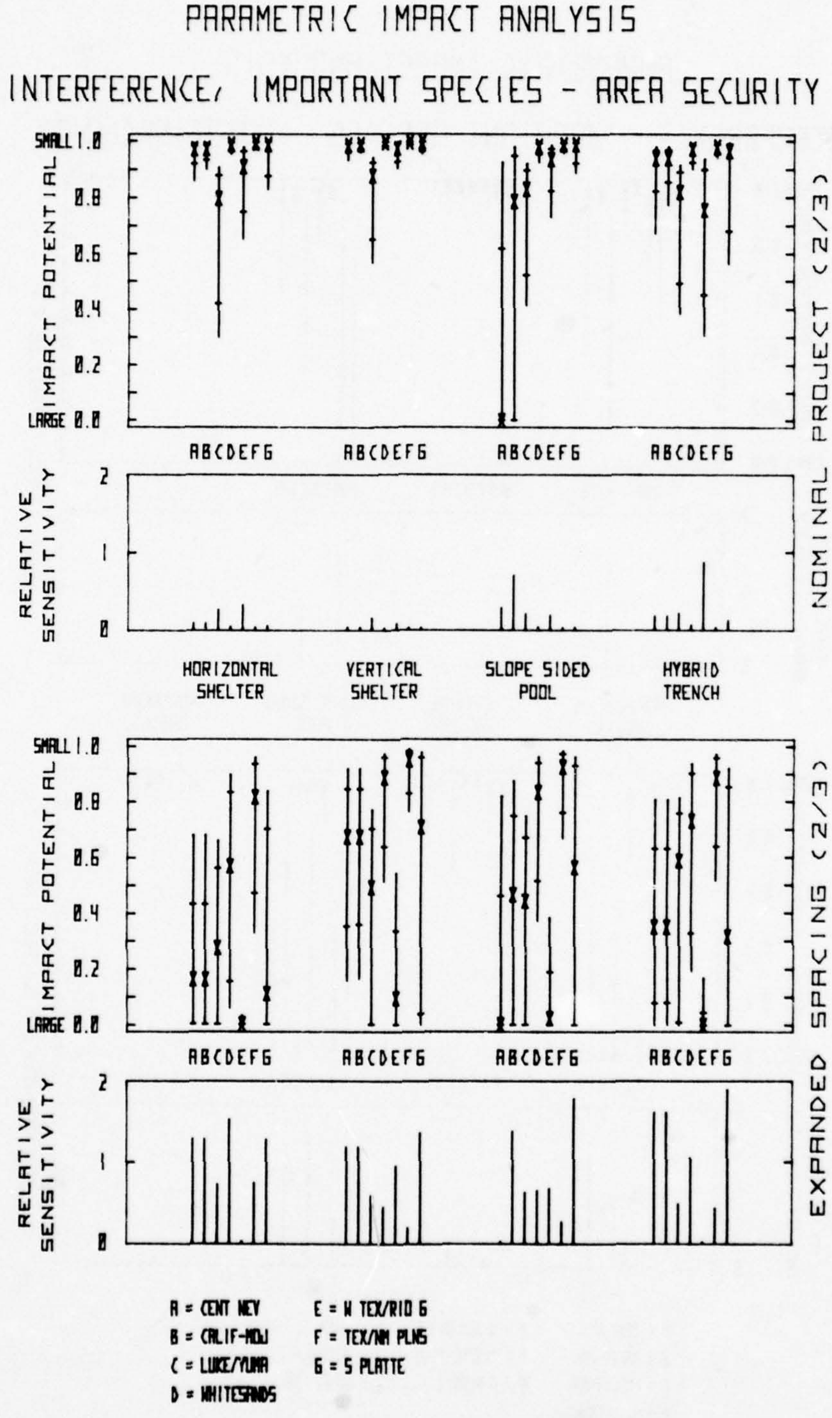


Figure A-1.



PARAMETRIC IMPACT ANALYSIS
INTERFERENCE/ IMPORTANT SPECIES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG ABCDEFG ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
ABCDEFG ABCDEFG ABCDEFG 123
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-2.



PARAMETRIC IMPACT ANALYSIS
INTERFERENCE, IMPORTANT SPECIES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-3.

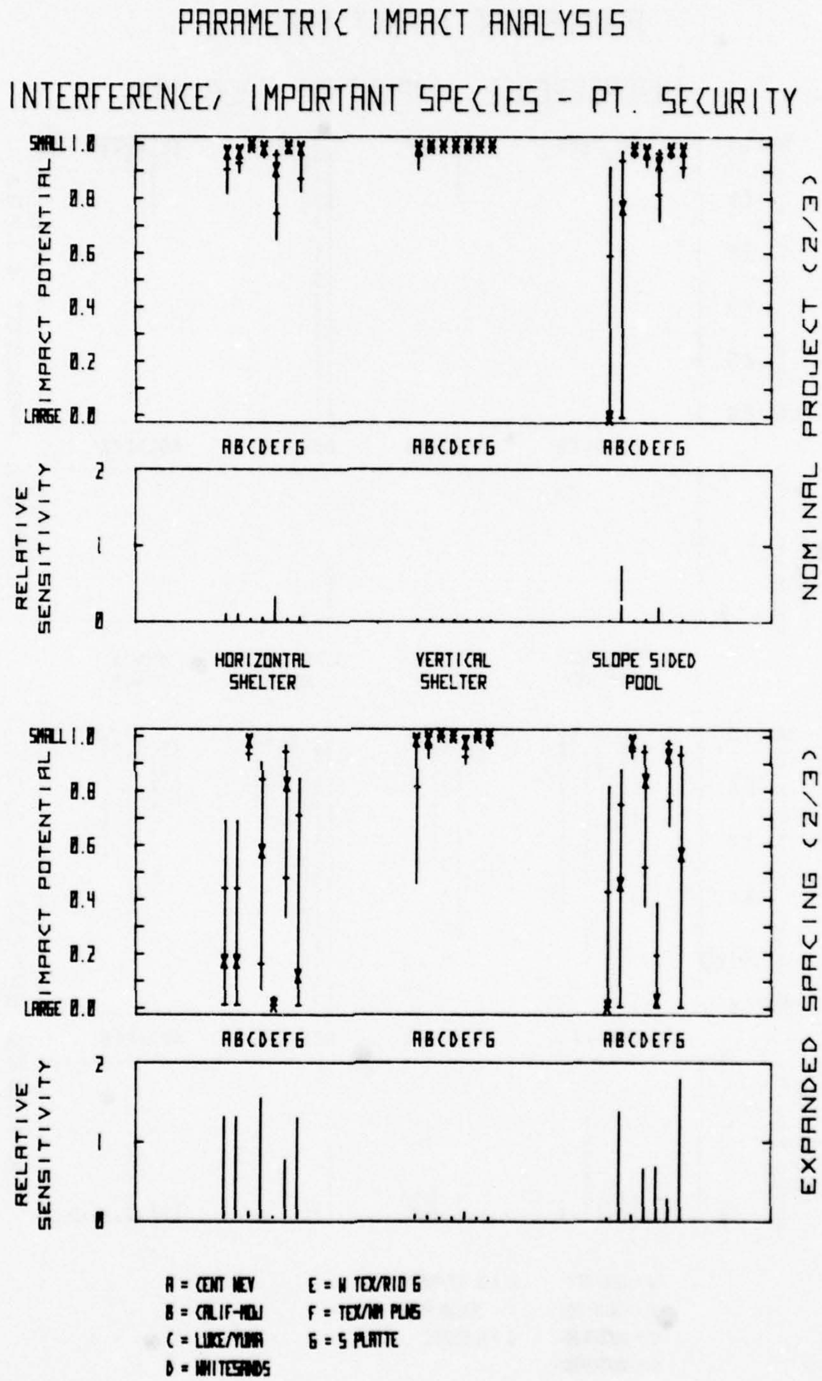

PARAMETRIC IMPACT ANALYSIS
INTERFERENCE, IMPORTANT SPECIES - PT. SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-4.

PARAMETRIC IMPACT ANALYSIS

INTERFERENCE, IMPORTANT SPECIES

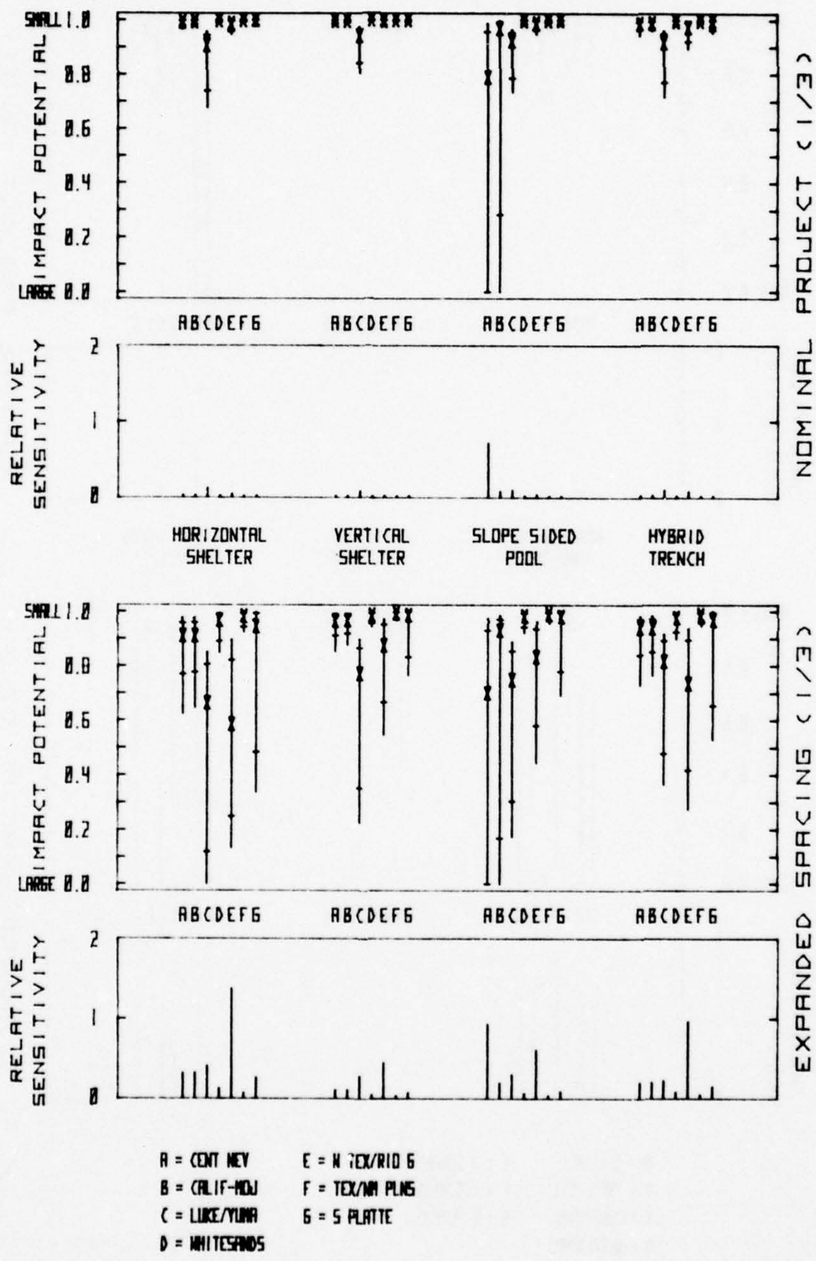


Figure A-5.

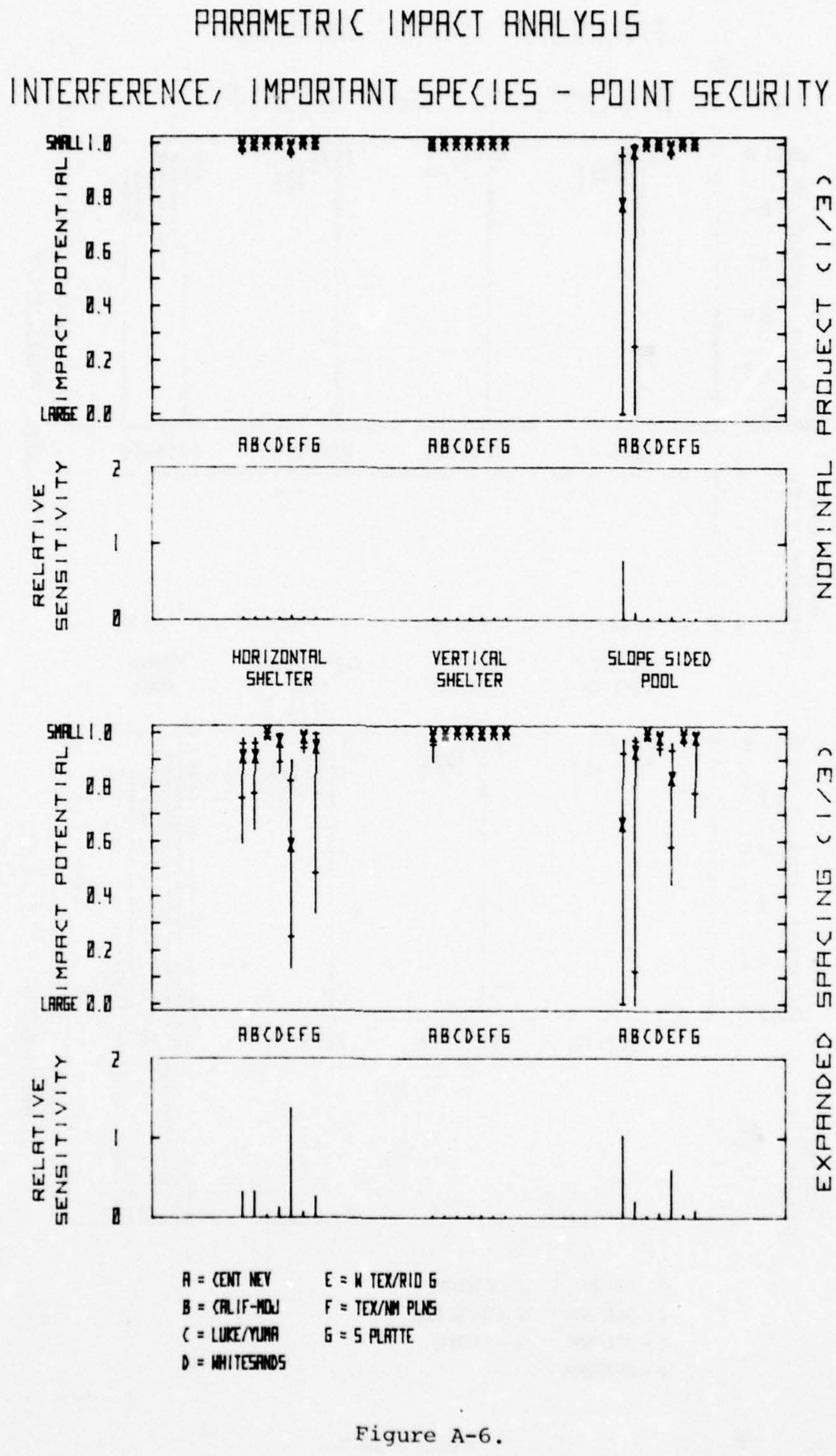

PARAMETRIC IMPACT ANALYSIS
INTERFERENCE, IMPORTANT SPECIES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-6.

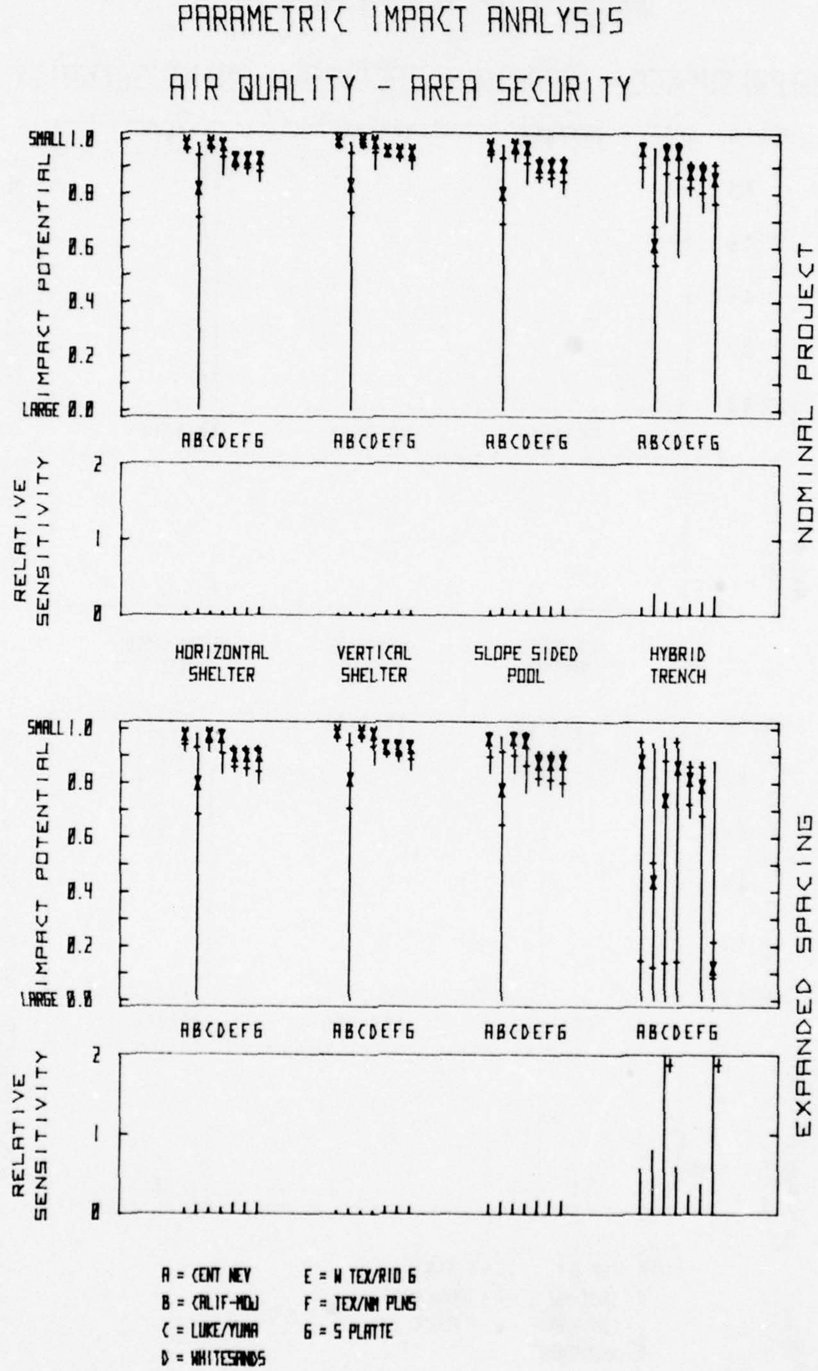
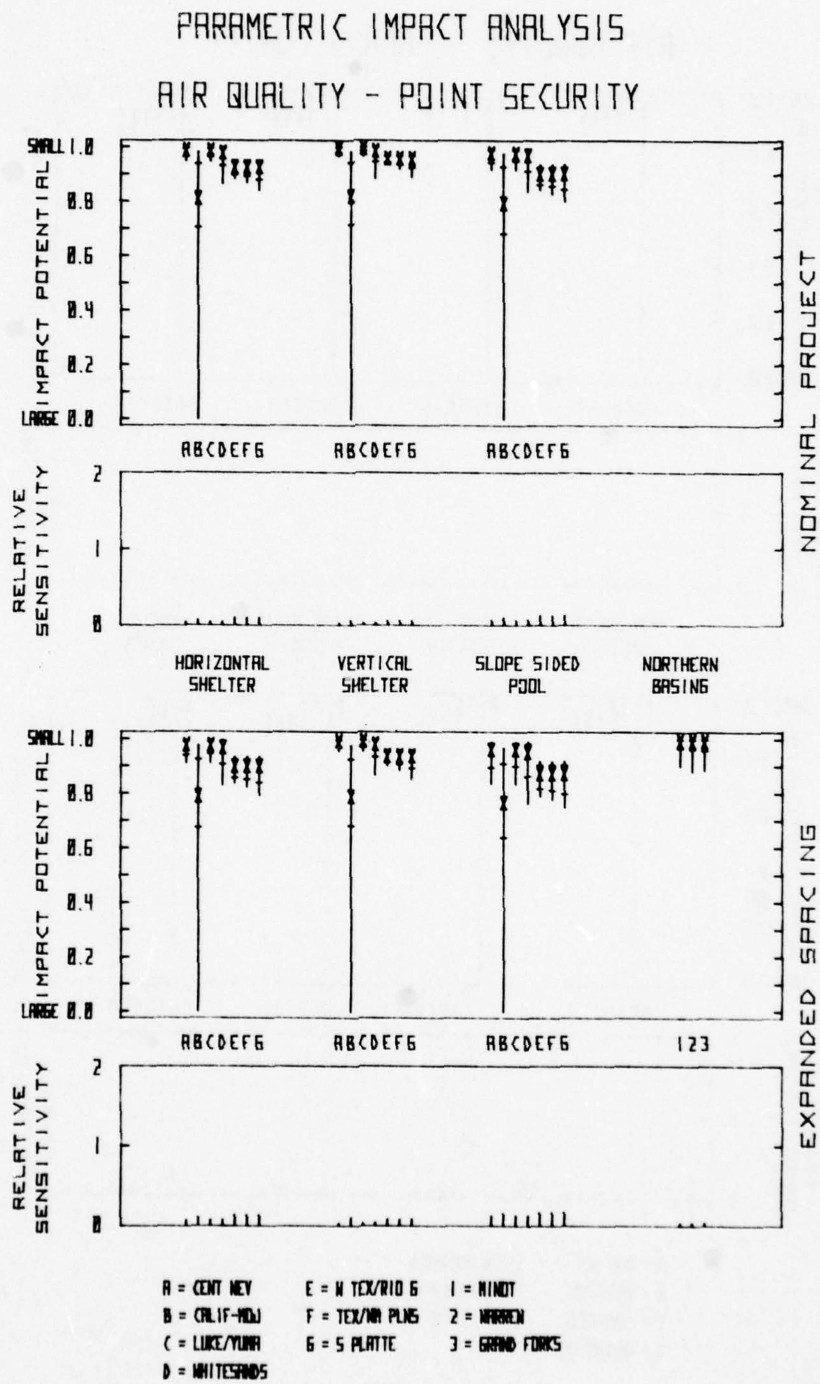

PARAMETRIC IMPACT ANALYSIS
AIR QUALITY - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-7.



PARAMETRIC IMPACT ANALYSIS
AIR QUALITY - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-8.

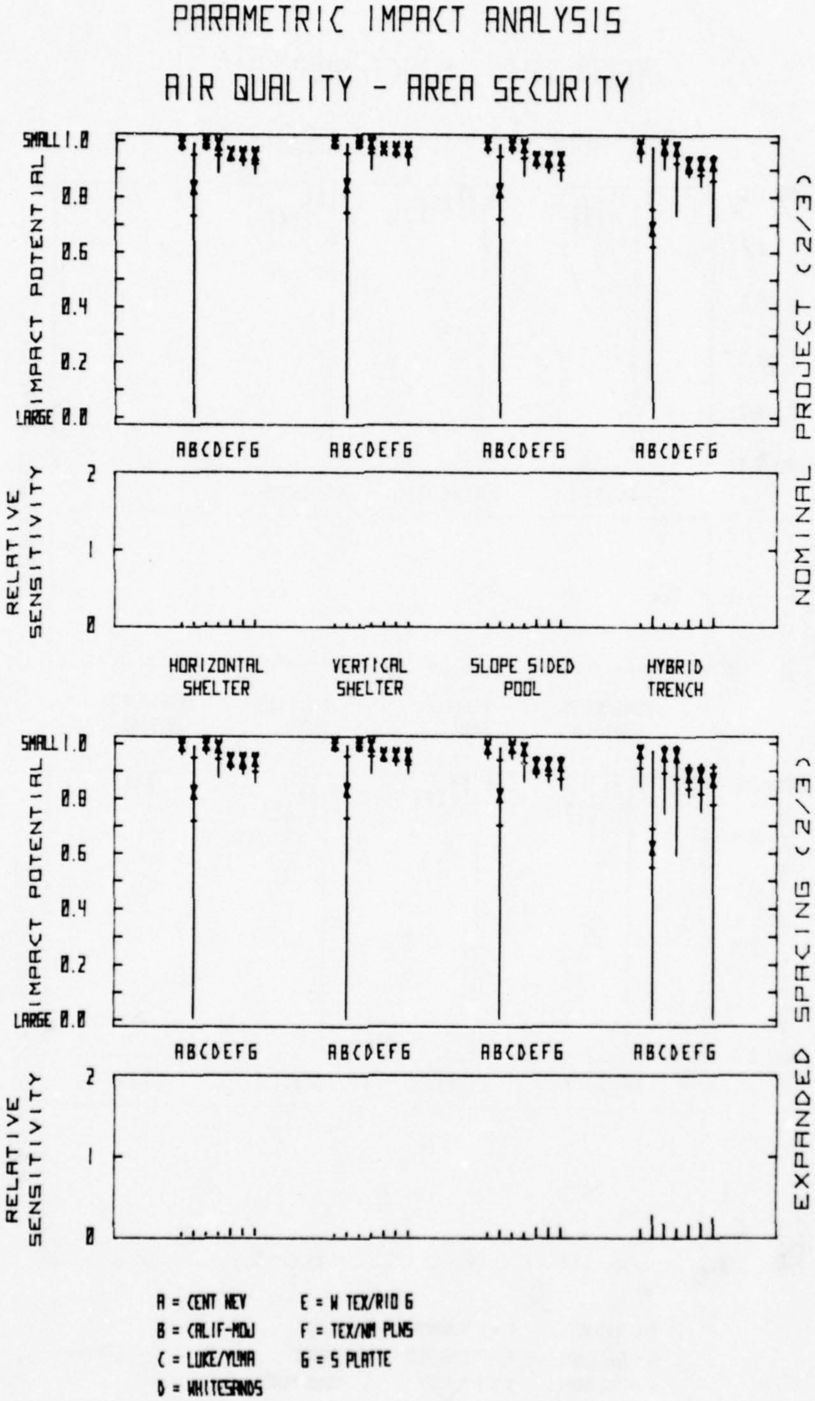

PARAMETRIC IMPACT ANALYSIS
AIR QUALITY - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-9.

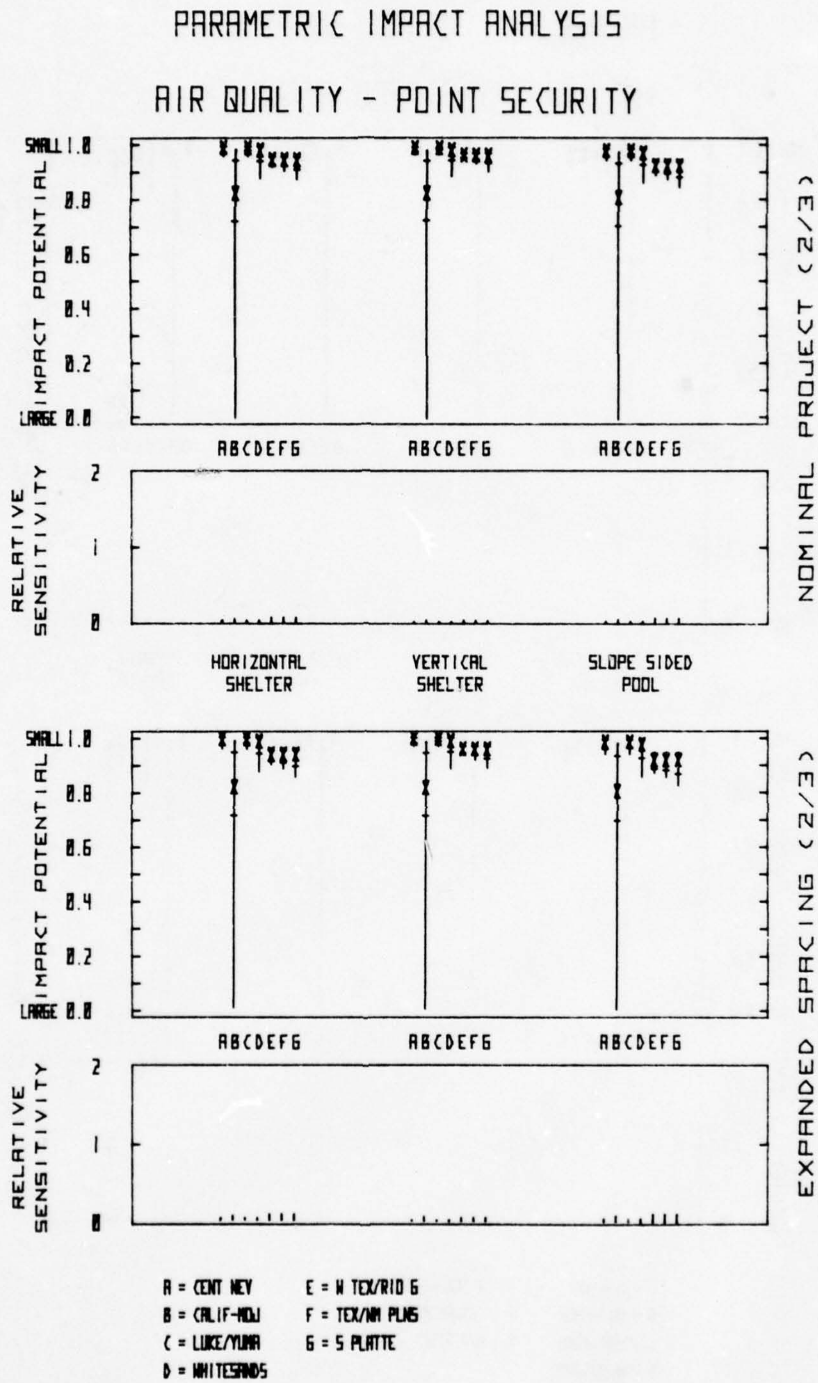

PARAMETRIC IMPACT ANALYSIS
AIR QUALITY - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-10.

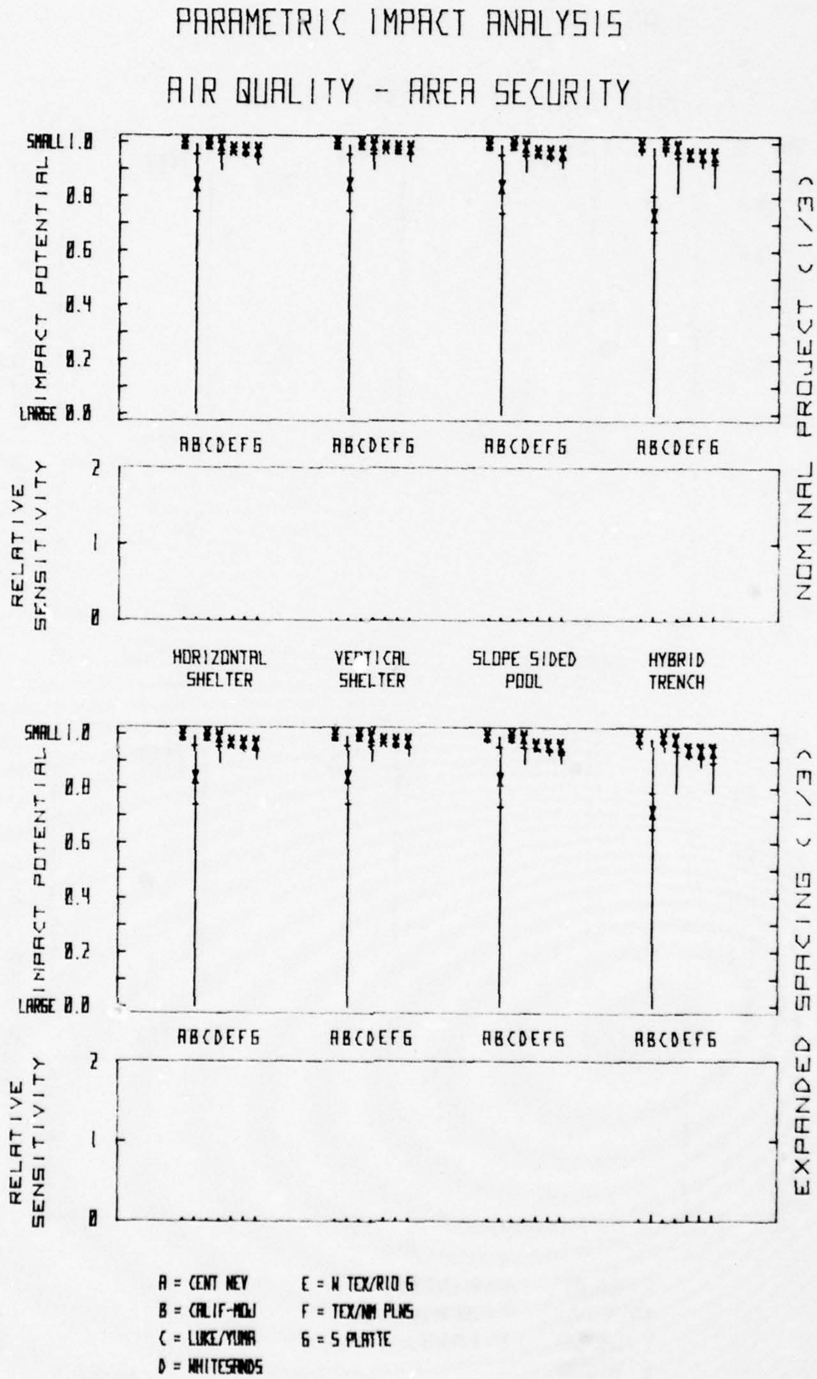

PARAMETRIC IMPACT ANALYSIS
AIR QUALITY - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-11.

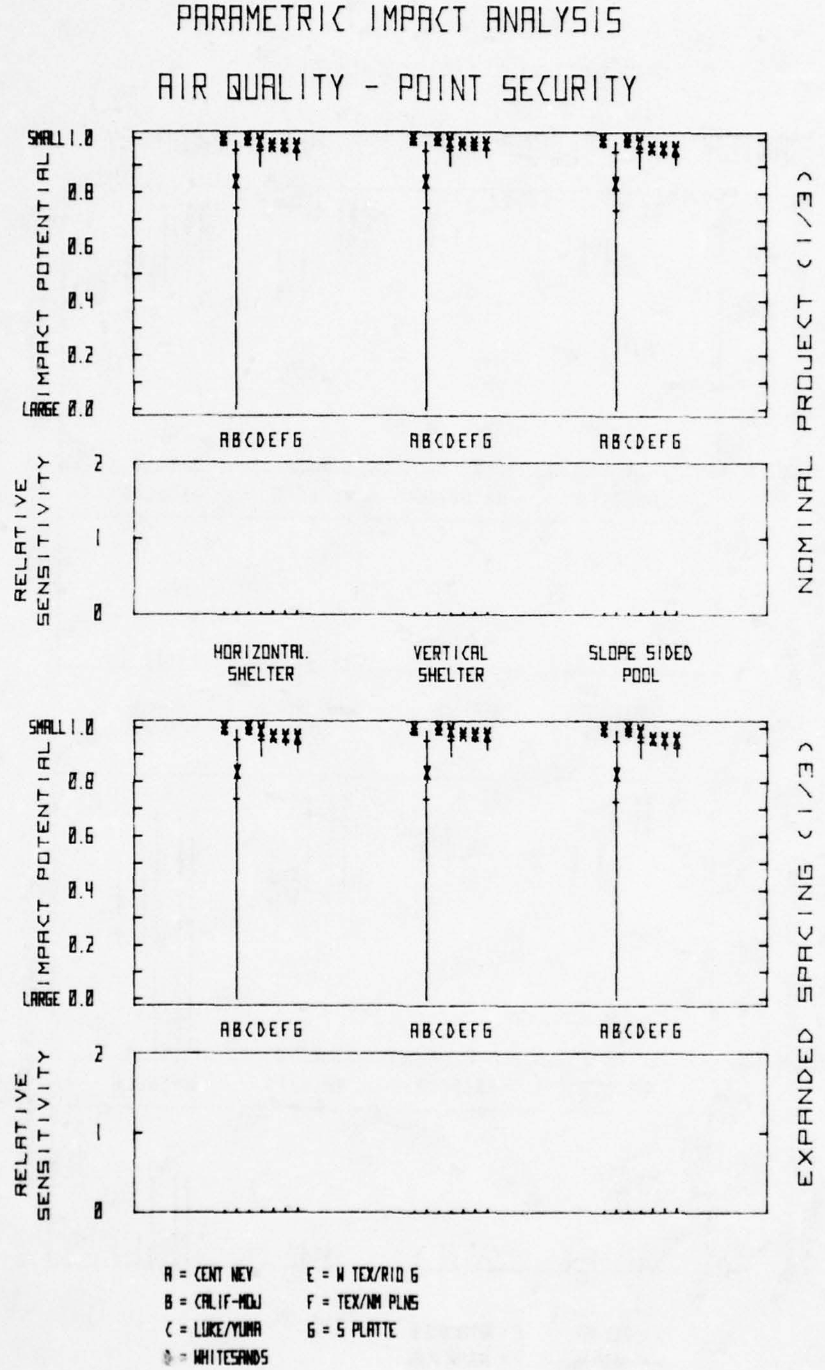

PARAMETRIC IMPACT ANALYSIS
AIR QUALITY - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-12.

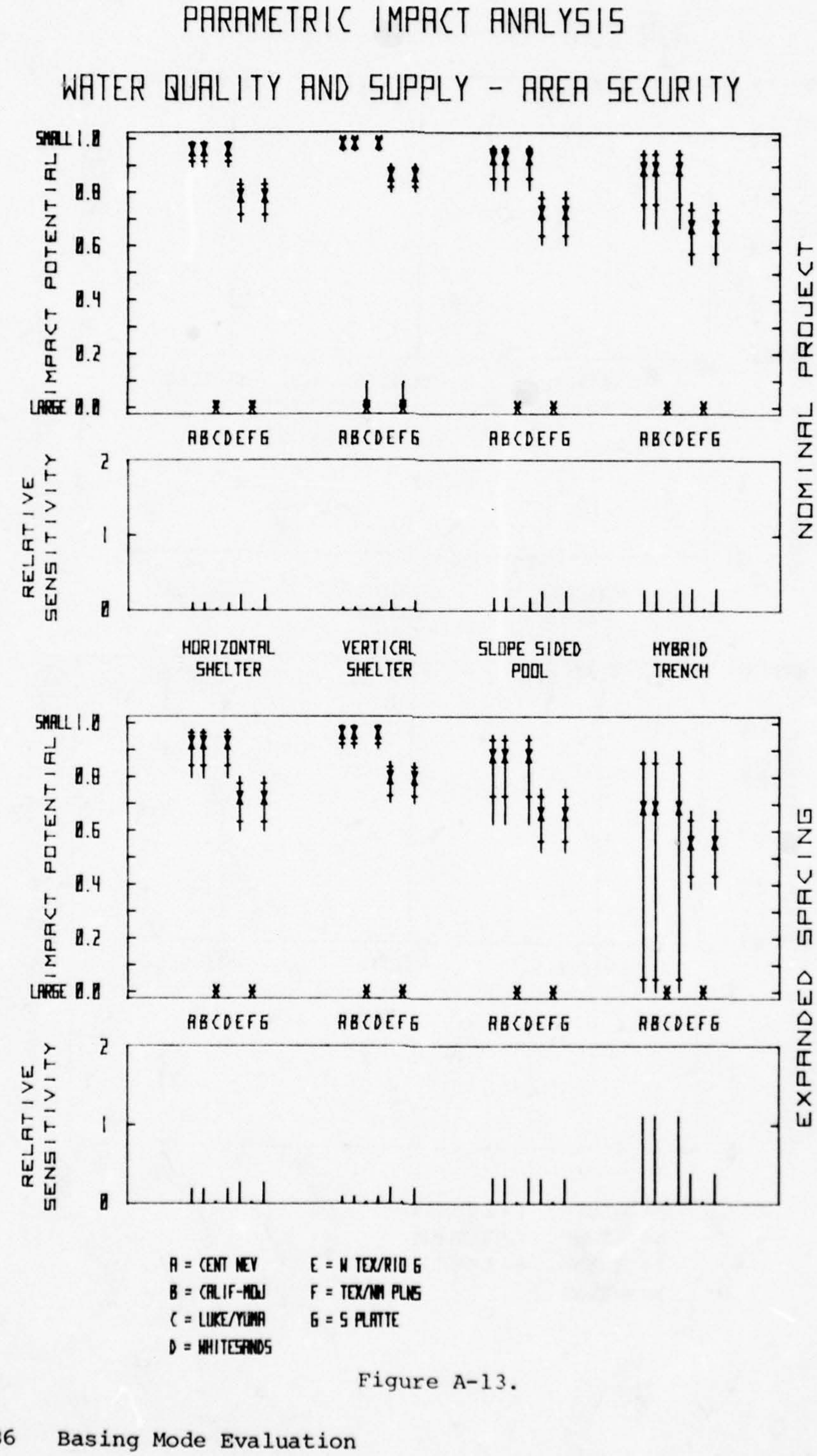

PARAMETRIC IMPACT ANALYSIS
WATER QUALITY AND SUPPLY - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-13.

PARAMETRIC IMPACT ANALYSIS

WATER QUALITY AND SUPPLY - POINT SECURITY

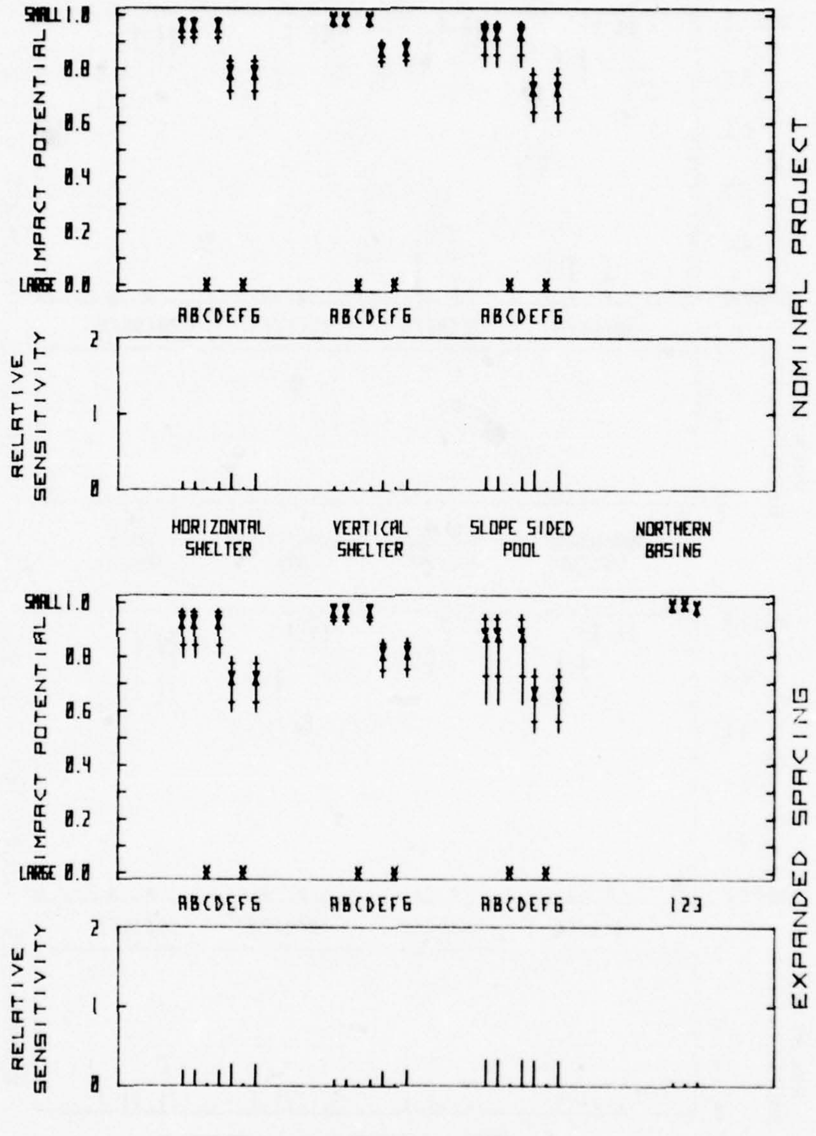


Figure A-14.

PARAMETRIC IMPACT ANALYSIS

WATER QUALITY AND SUPPLY - AREA SECURITY

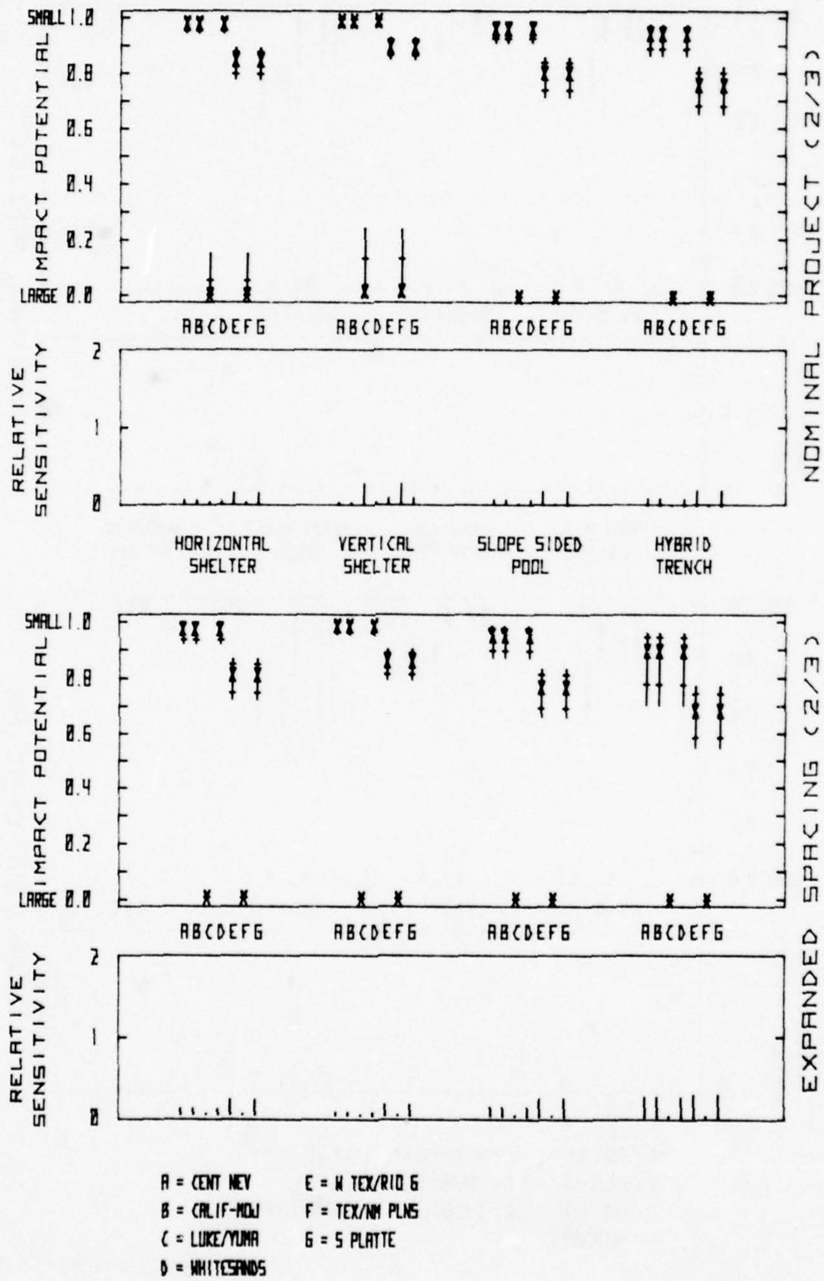


Figure A-15.

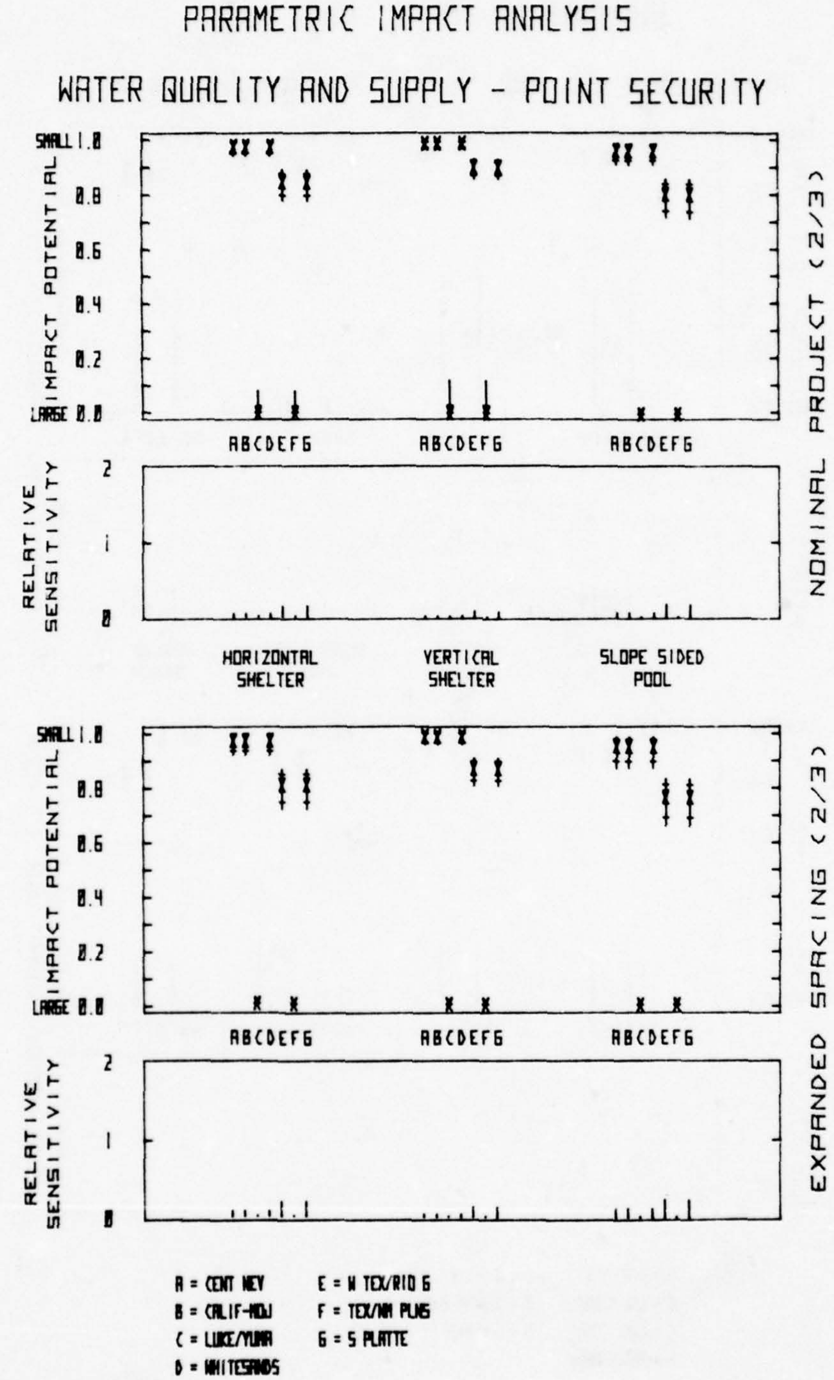

PARAMETRIC IMPACT ANALYSIS
WATER QUALITY AND SUPPLY - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-16.

PARAMETRIC IMPACT ANALYSIS

WATER QUALITY AND SUPPLY - AREA SECURITY

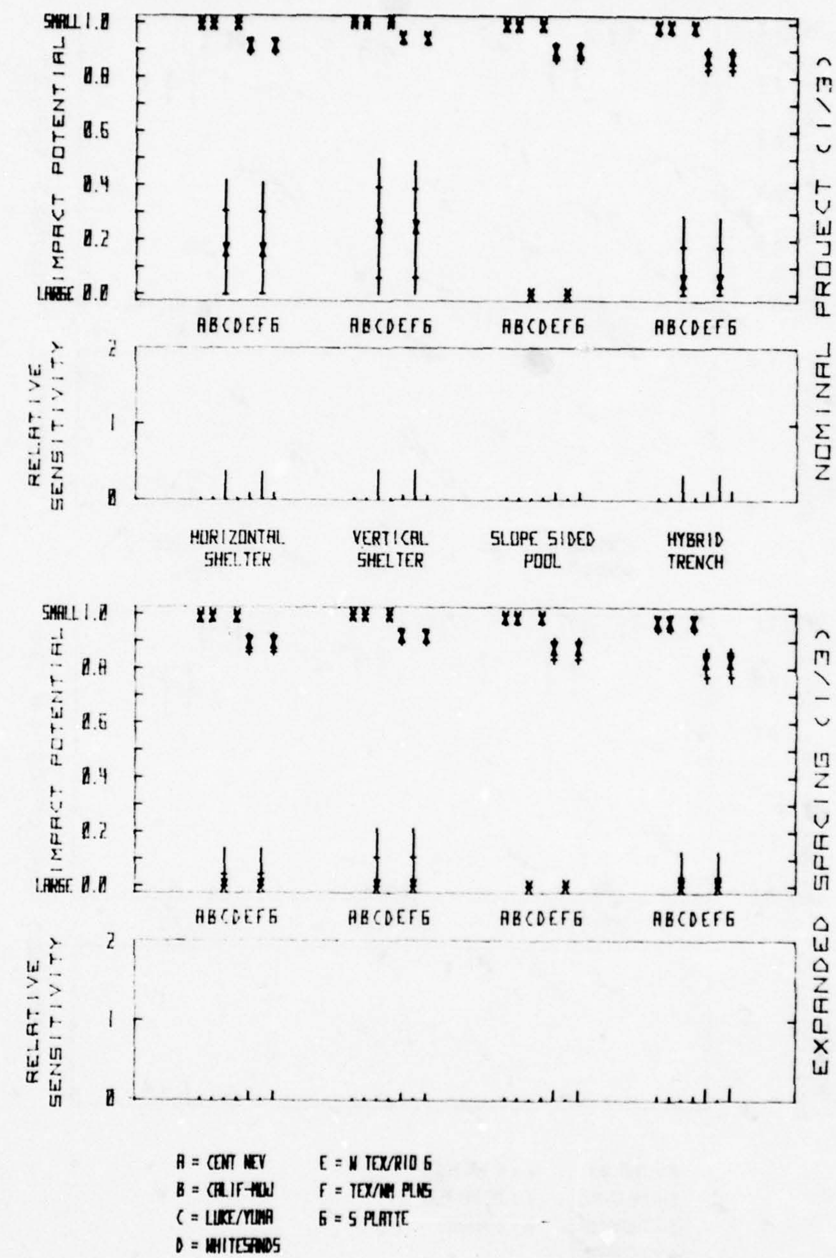


Figure A-17.

PARAMETRIC IMPACT ANALYSIS

WATER QUALITY AND SUPPLY - POINT SECURITY

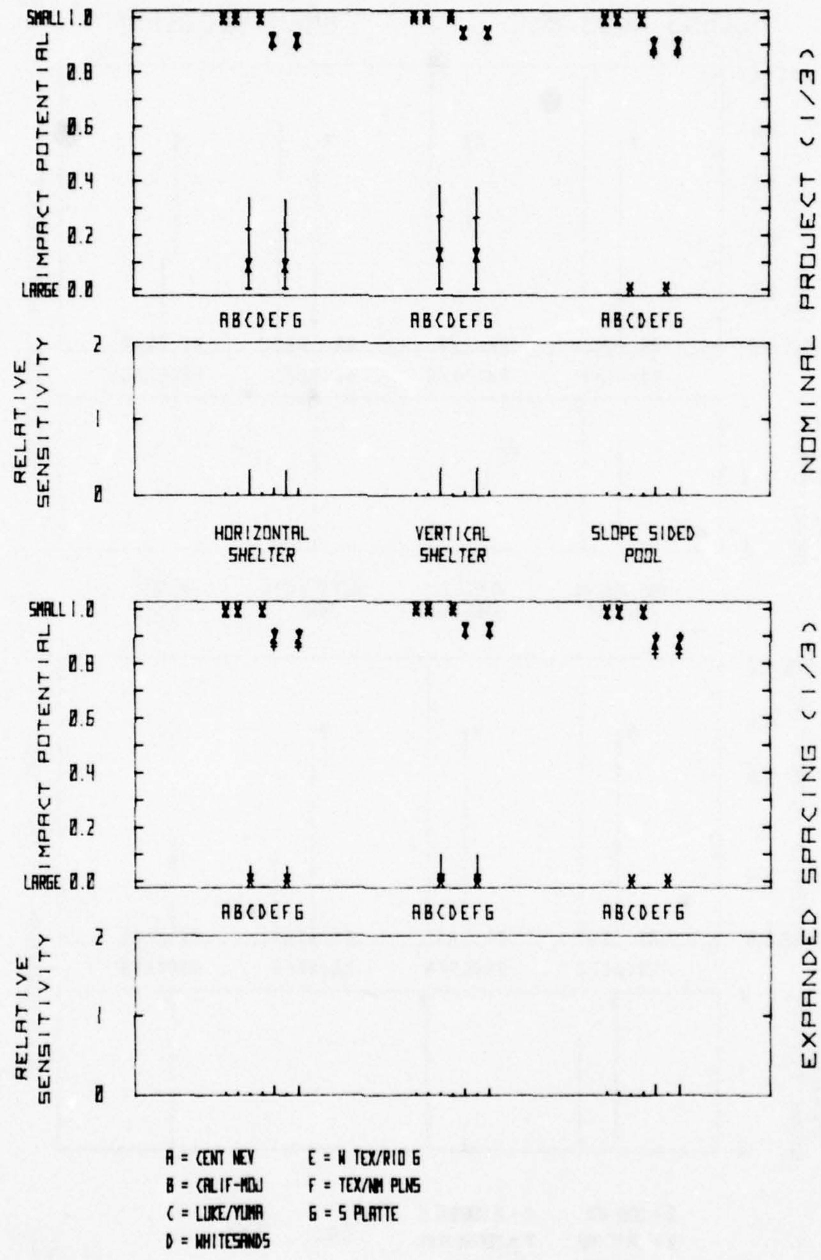
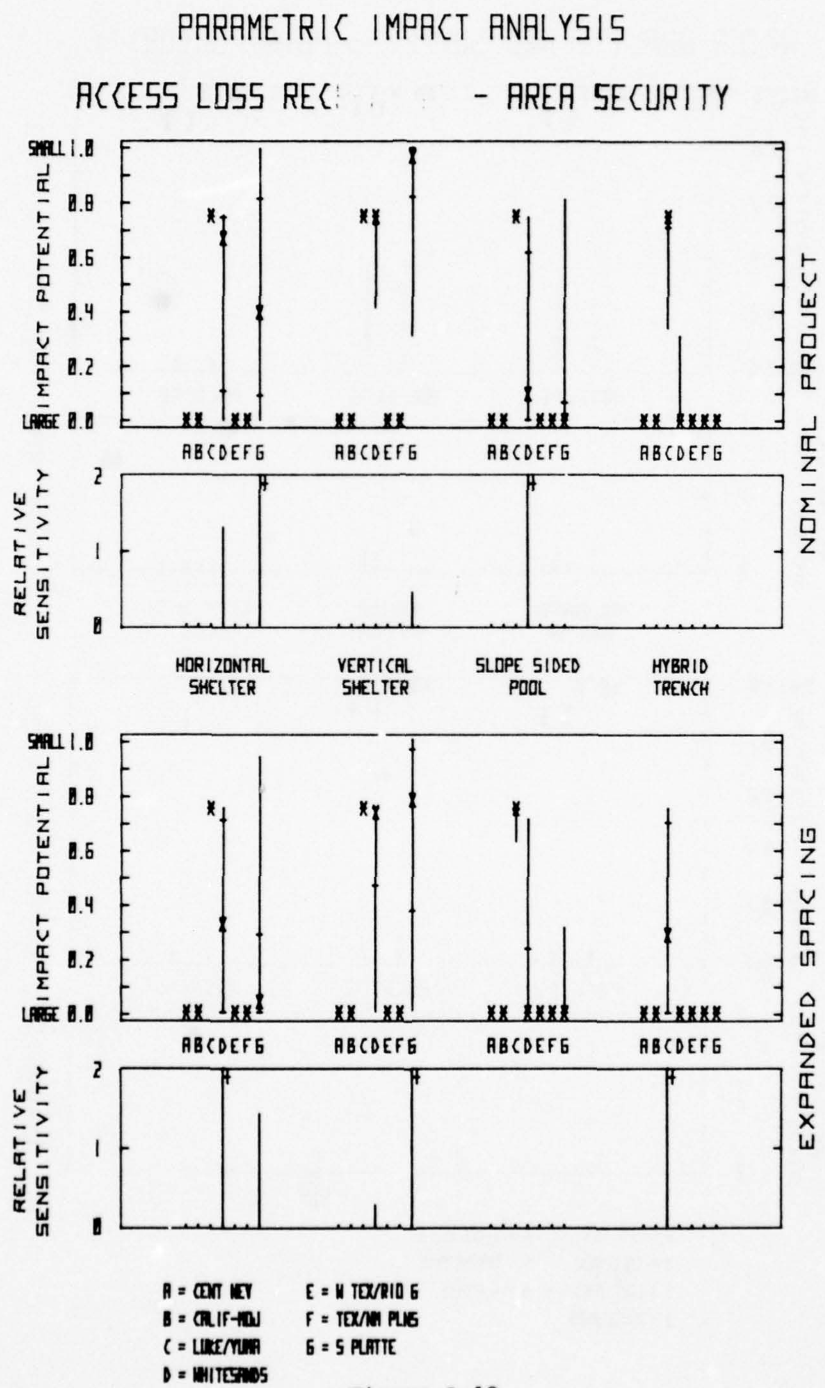


Figure A-18.


PARAMETRIC IMPACT ANALYSIS
ACCESS LOSS REC - AREA SECURITY
IMPACT POTENTIAL
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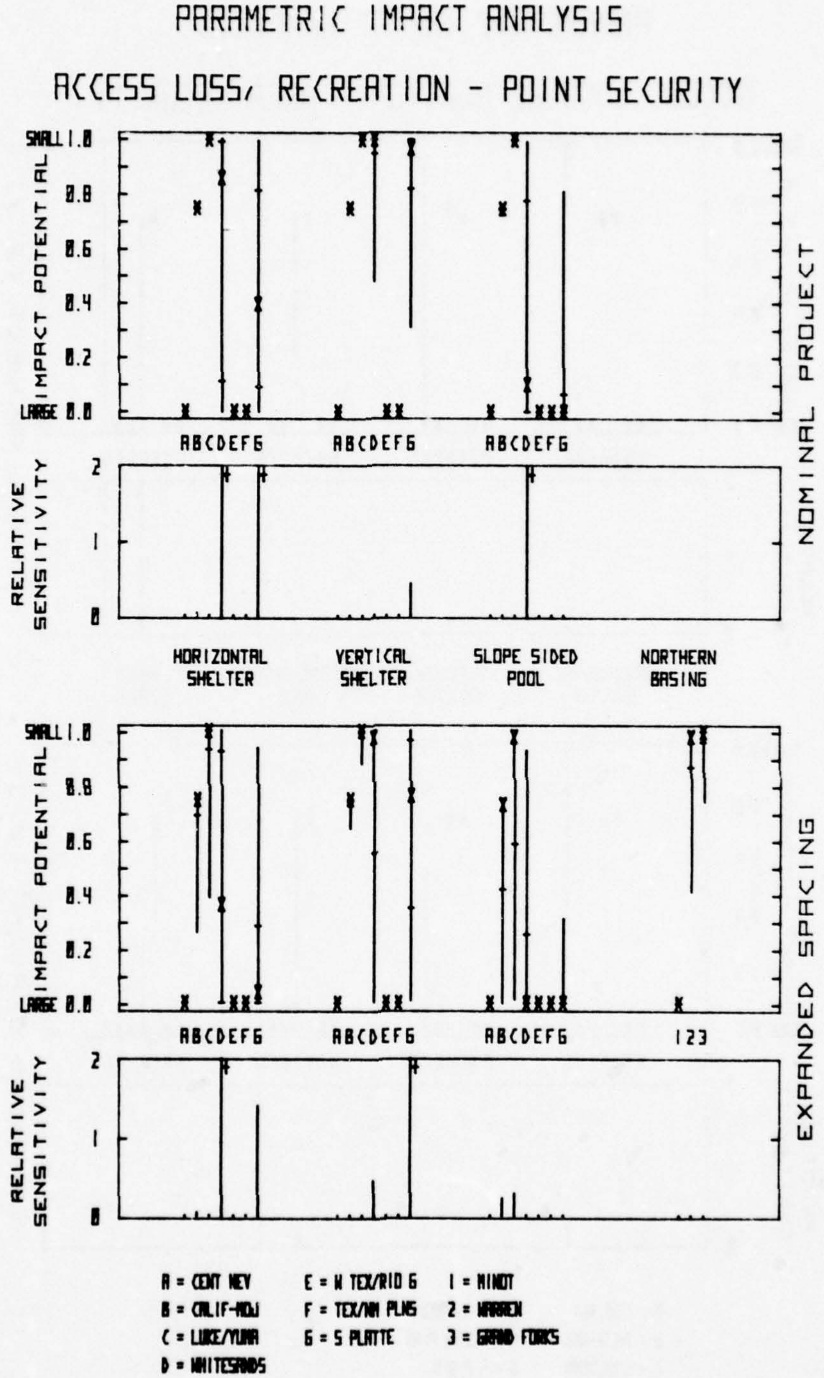
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-19.


PARAMETRIC IMPACT ANALYSIS
ACCESS LOSS, RECREATION - POINT SECURITY
SMALL 1.0
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0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-20.

PARAMETRIC IMPACT ANALYSIS

ACCESS LOSS RECREATION - AREA SECURITY

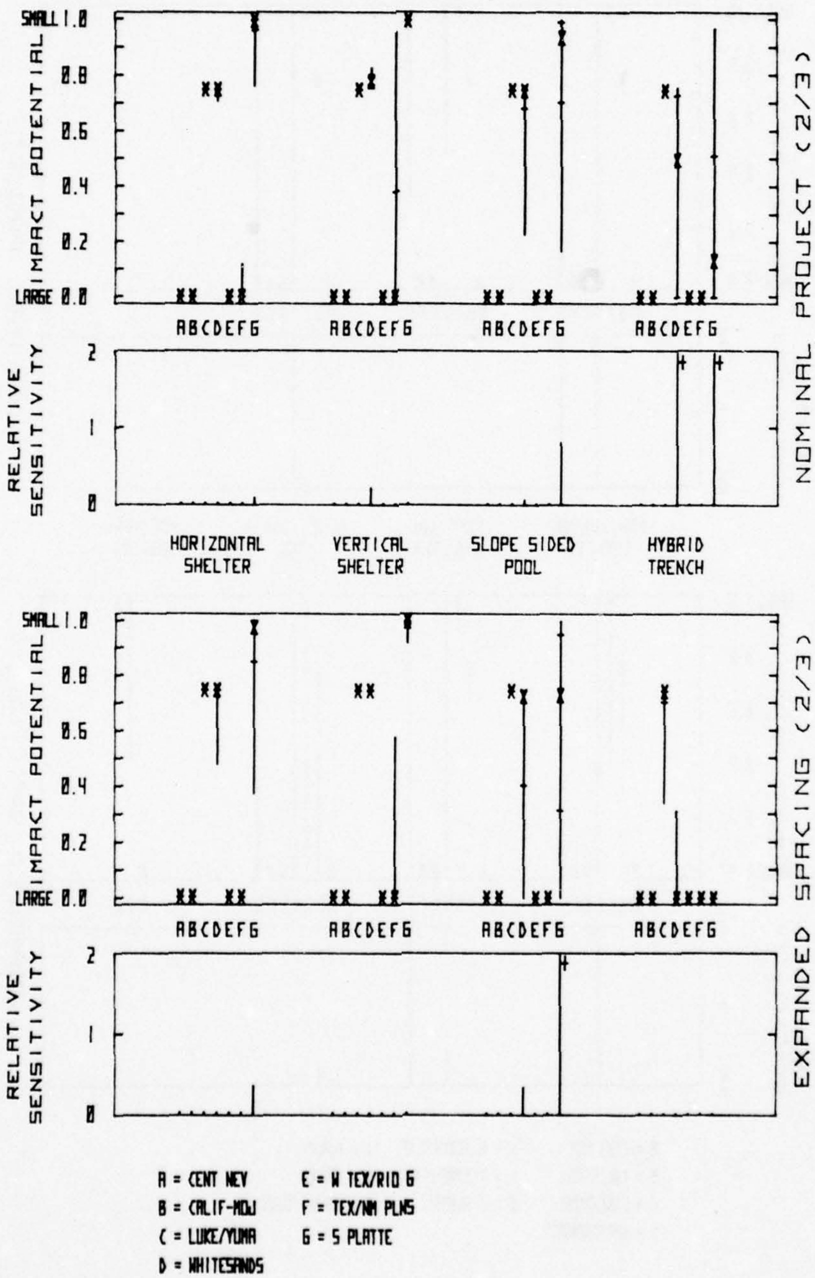


Figure A-21.

PARAMETRIC IMPACT ANALYSIS

ACCESS LOSS RECREATION - POINT SECURITY

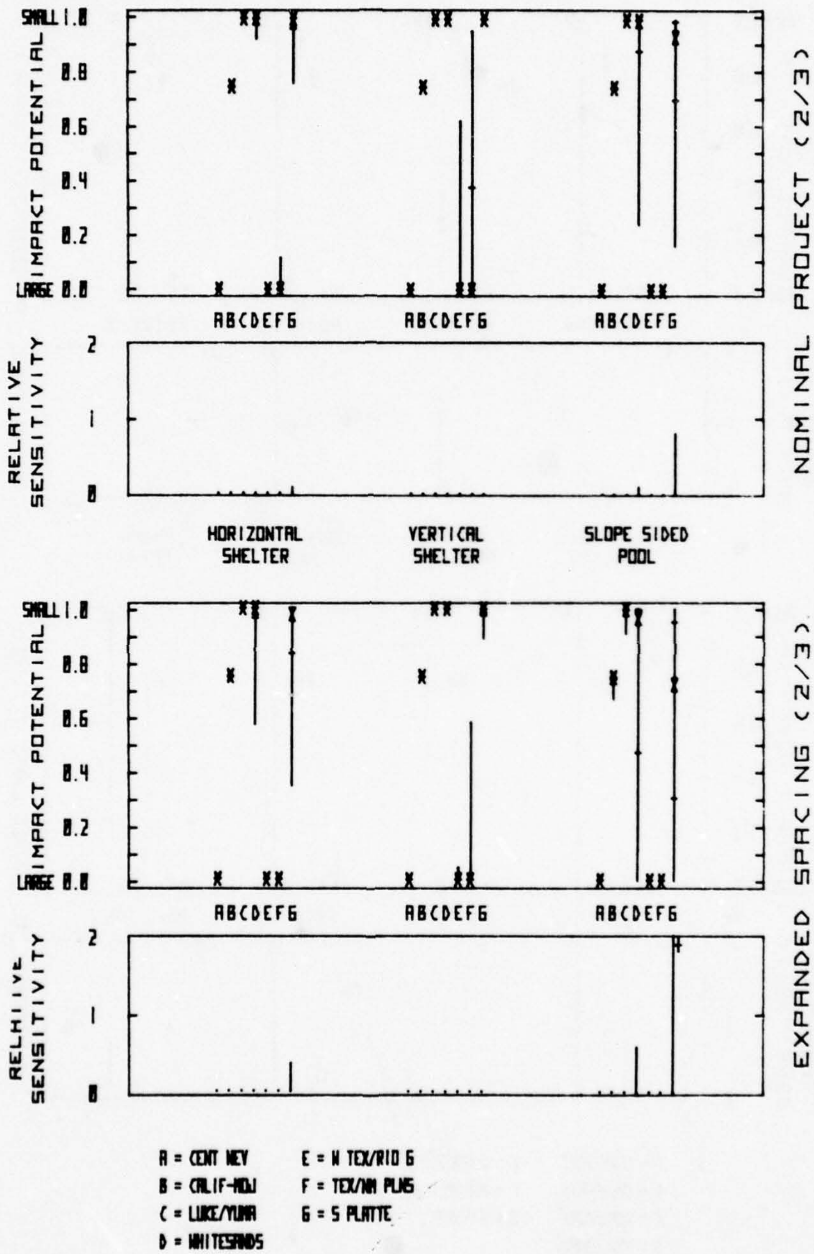


Figure A-22.

PARAMETRIC IMPACT ANALYSIS

ACCESS LOSS/ RECREATION - AREA SECURITY

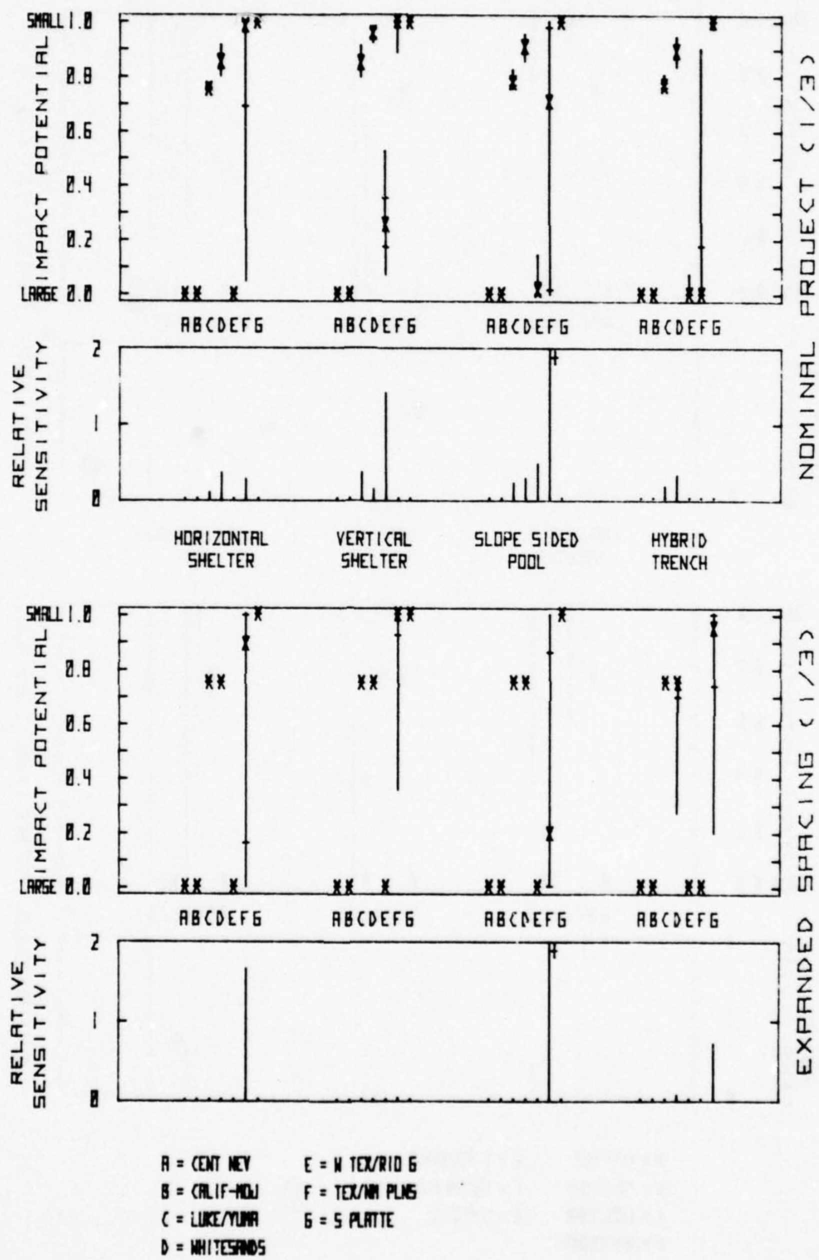
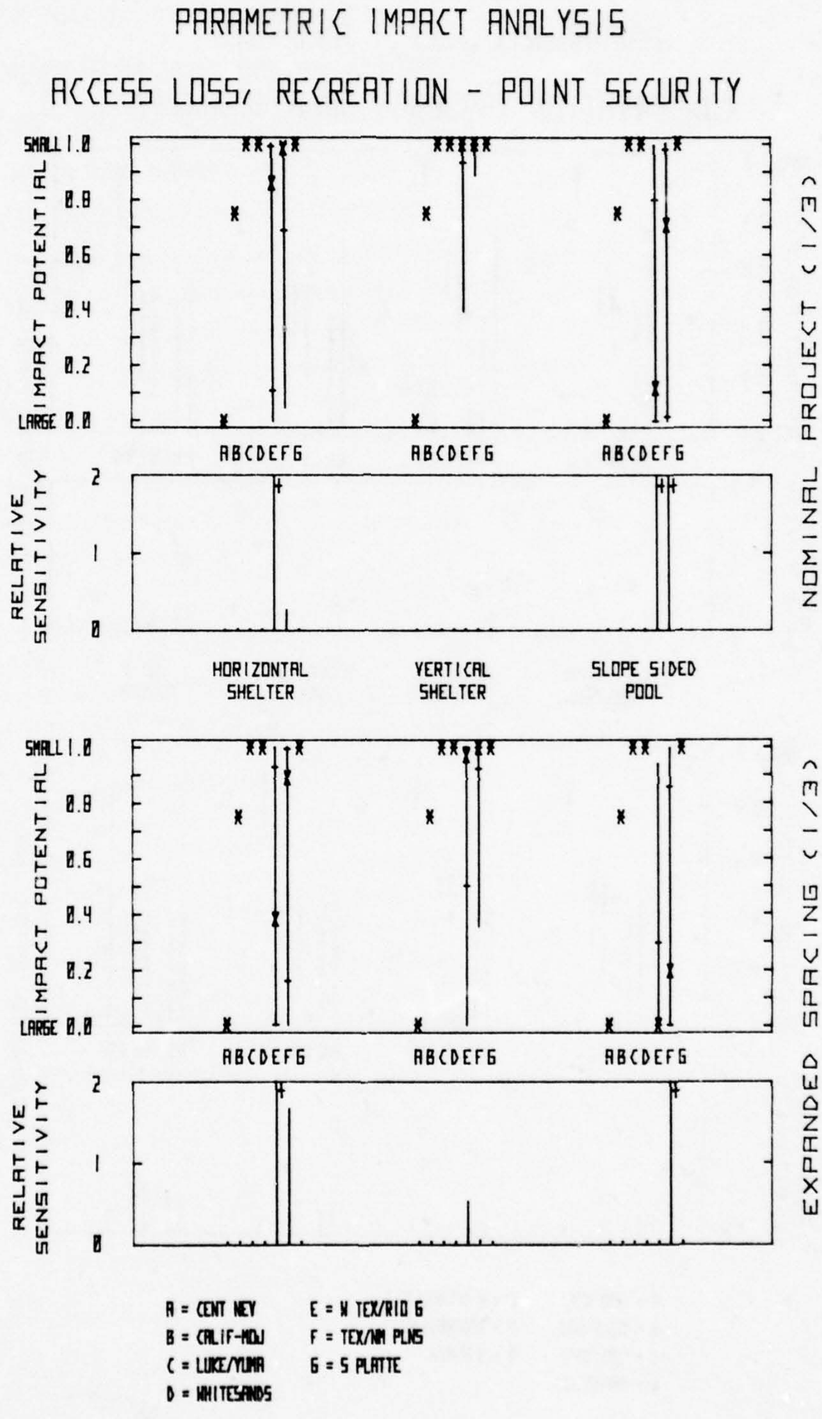


Figure A-23.


PARAMETRIC IMPACT ANALYSIS
ACCESS LOSS, RECREATION - POINT SECURITY
SMALL 1.0
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0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-24.

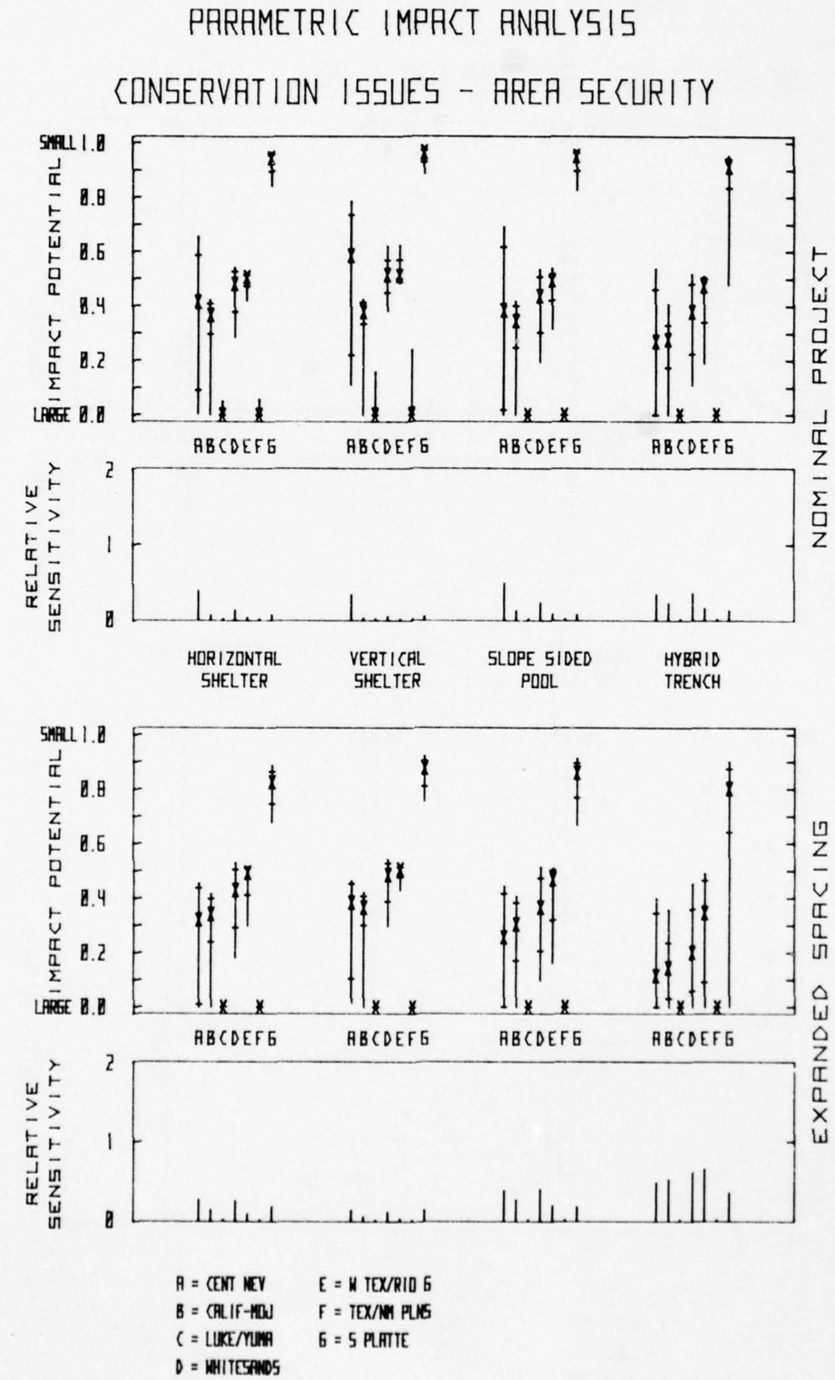

PARAMETRIC IMPACT ANALYSIS
CONSERVATION ISSUES - AREA SECURITY
NOMINAL PROJECT
EXPANDED SPACING
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-25.

PARAMETRIC IMPACT ANALYSIS

CONSERVATION ISSUES - POINT SECURITY

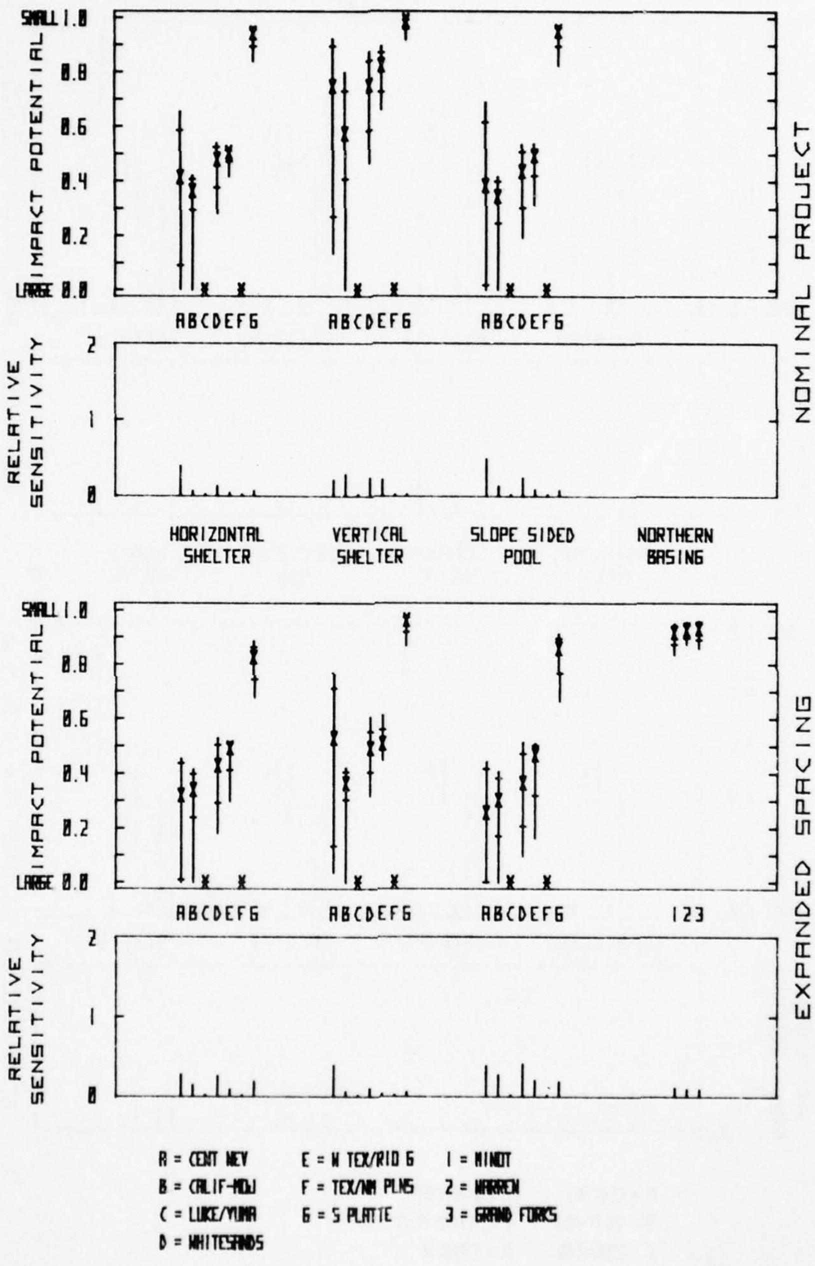
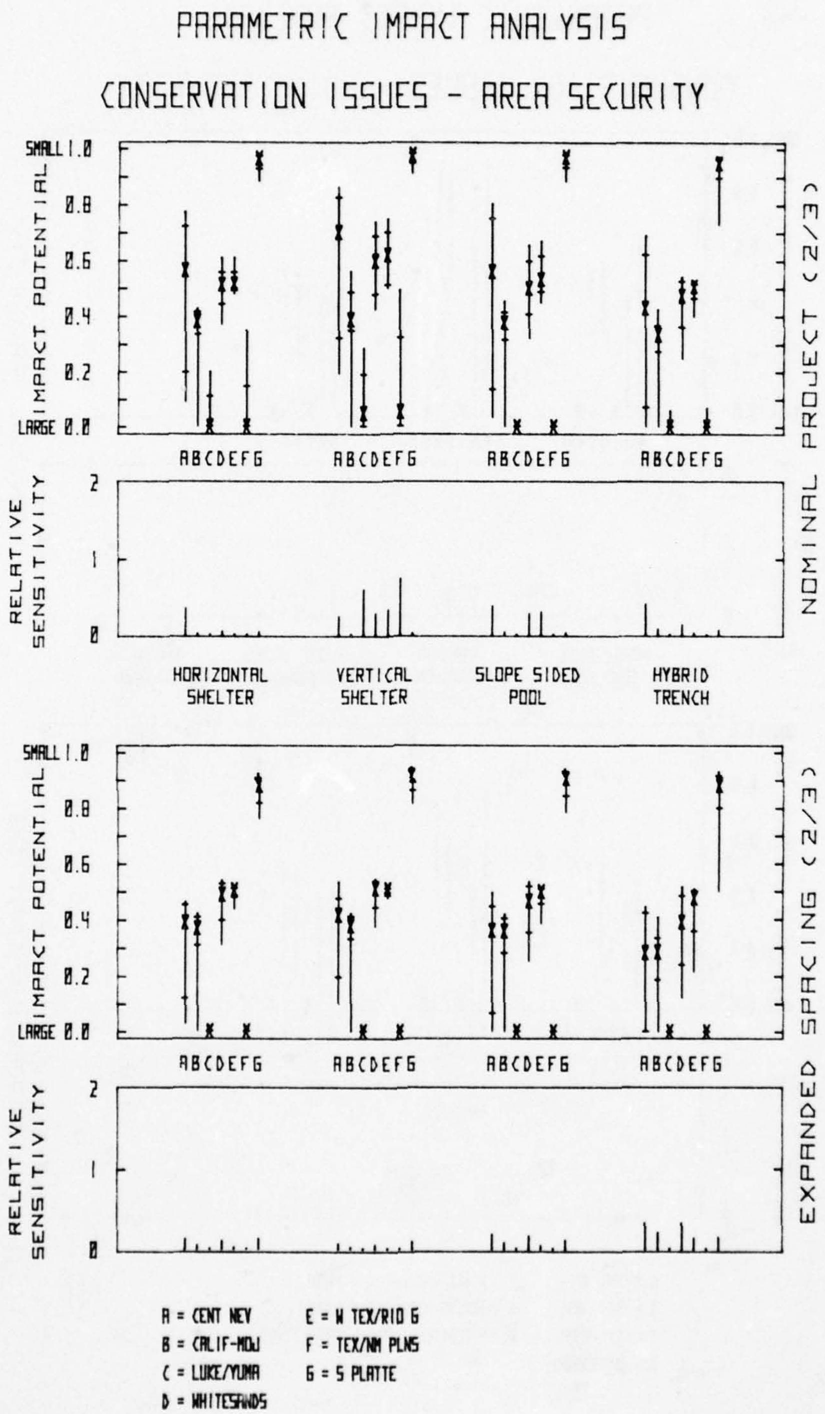


Figure A-26.


PARAMETRIC IMPACT ANALYSIS
CONSERVATION ISSUES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
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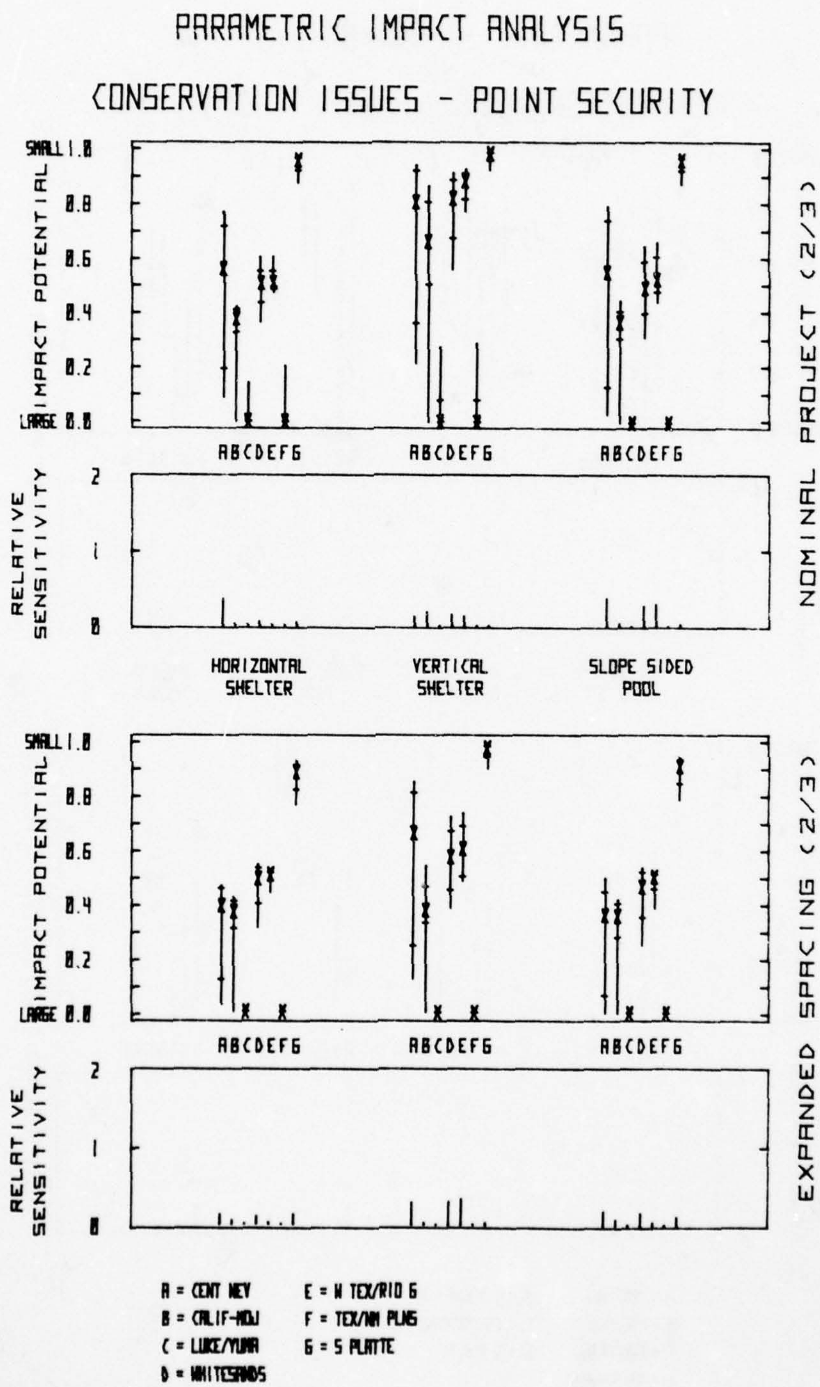
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-27.


PARAMETRIC IMPACT ANALYSIS
CONSERVATION ISSUES - POINT SECURITY
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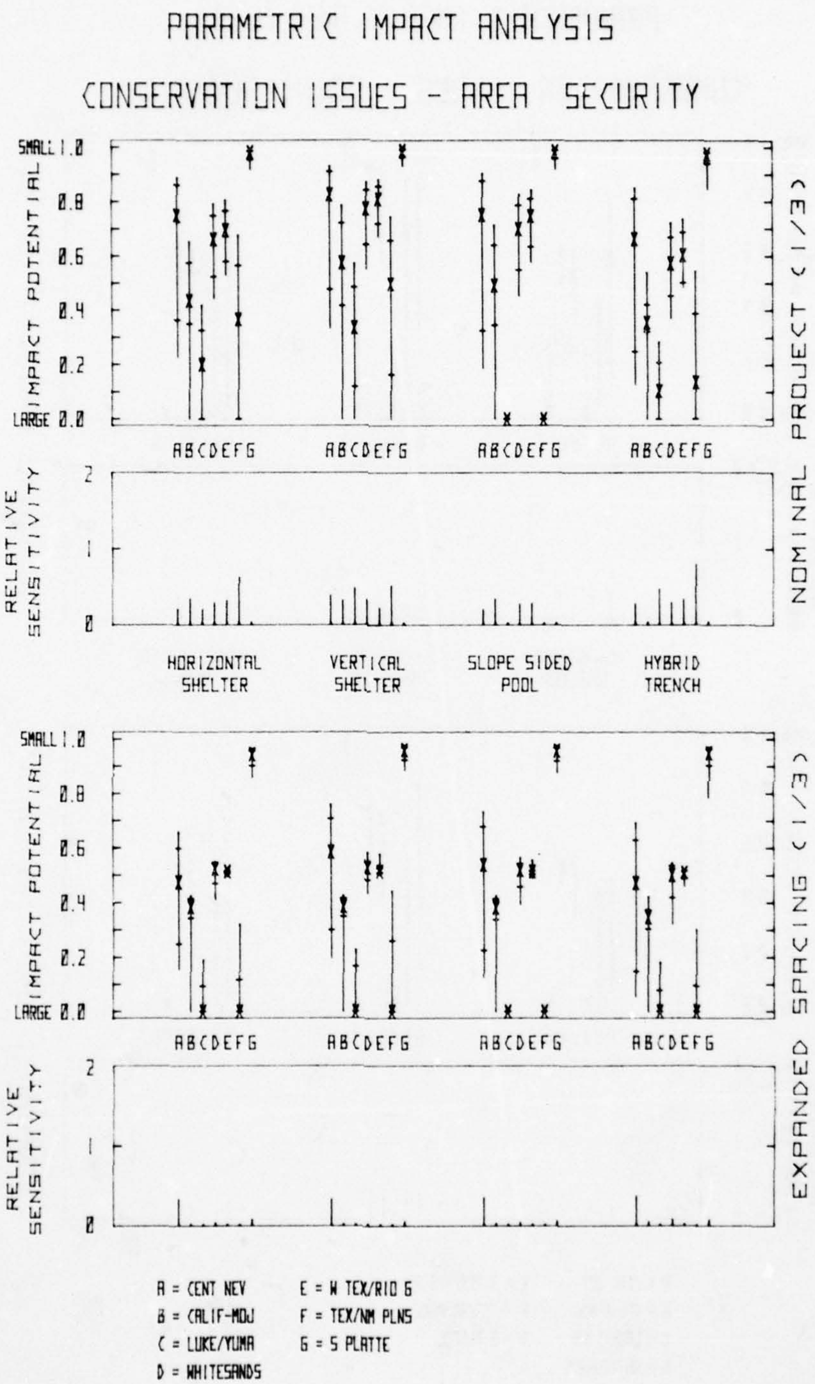
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NOV
C = LUKE/YUMA
D = WHITESANDS
E = N TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-28.


PARAMETRIC IMPACT ANALYSIS
CONSERVATION ISSUES - AREA SECURITY
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LARGE 0.0
IMPACT POTENTIAL
RELATIVE SENSITIVITY
ABCDEFG
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-29.

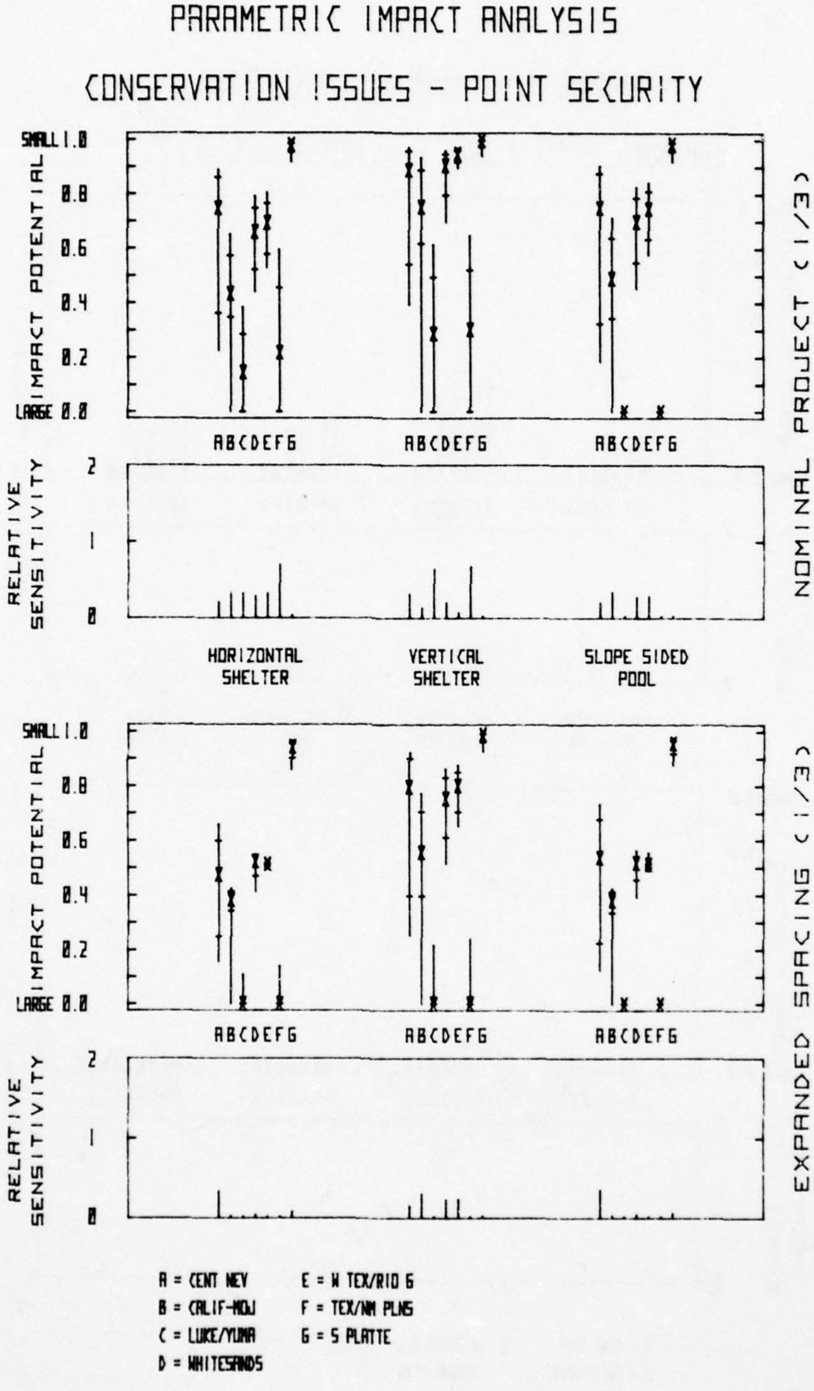
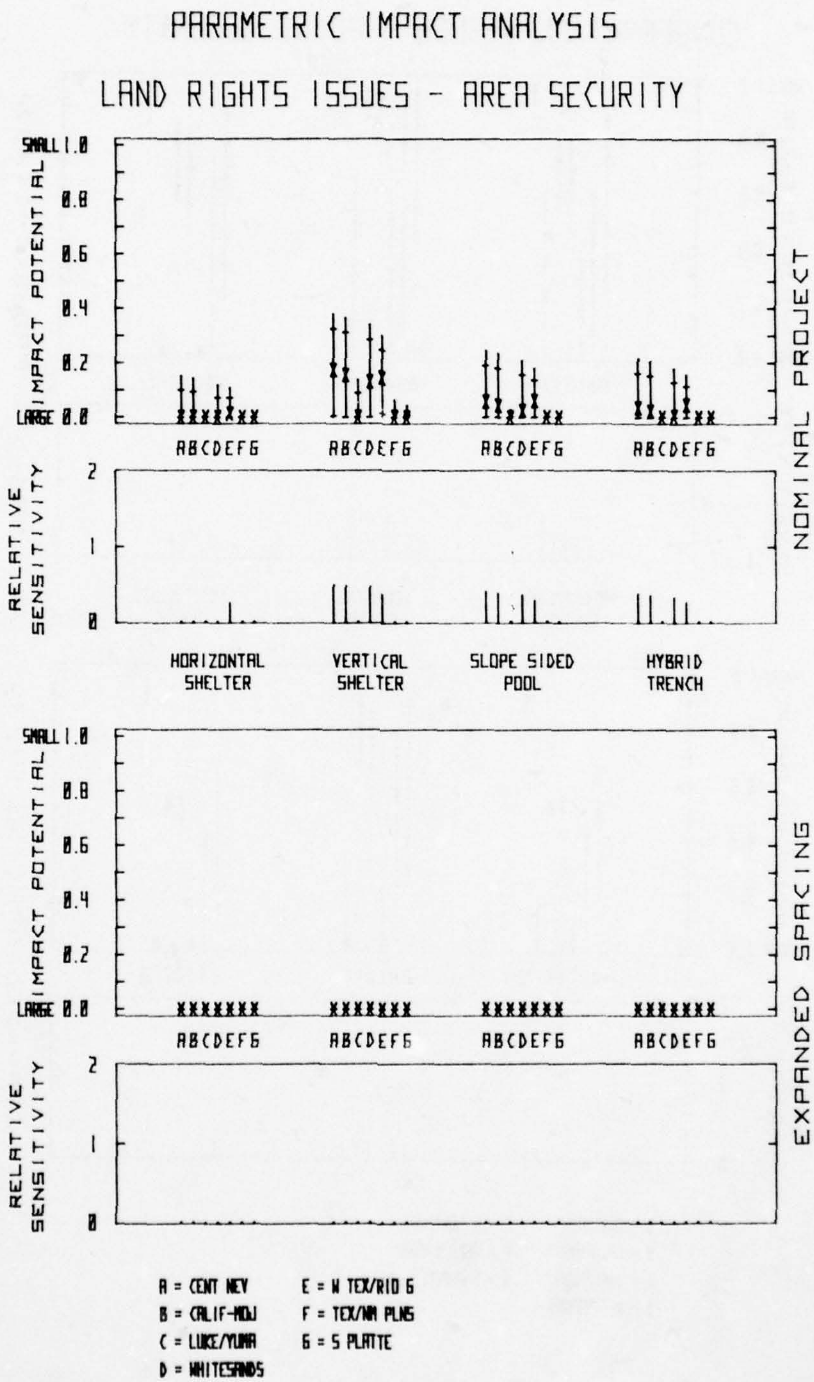

PARAMETRIC IMPACT ANALYSIS
CONSERVATION ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-30.



PARAMETRIC IMPACT ANALYSIS
LAND RIGHTS ISSUES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-31.

PARAMETRIC IMPACT ANALYSIS

LAND RIGHTS ISSUES - POINT SECURITY

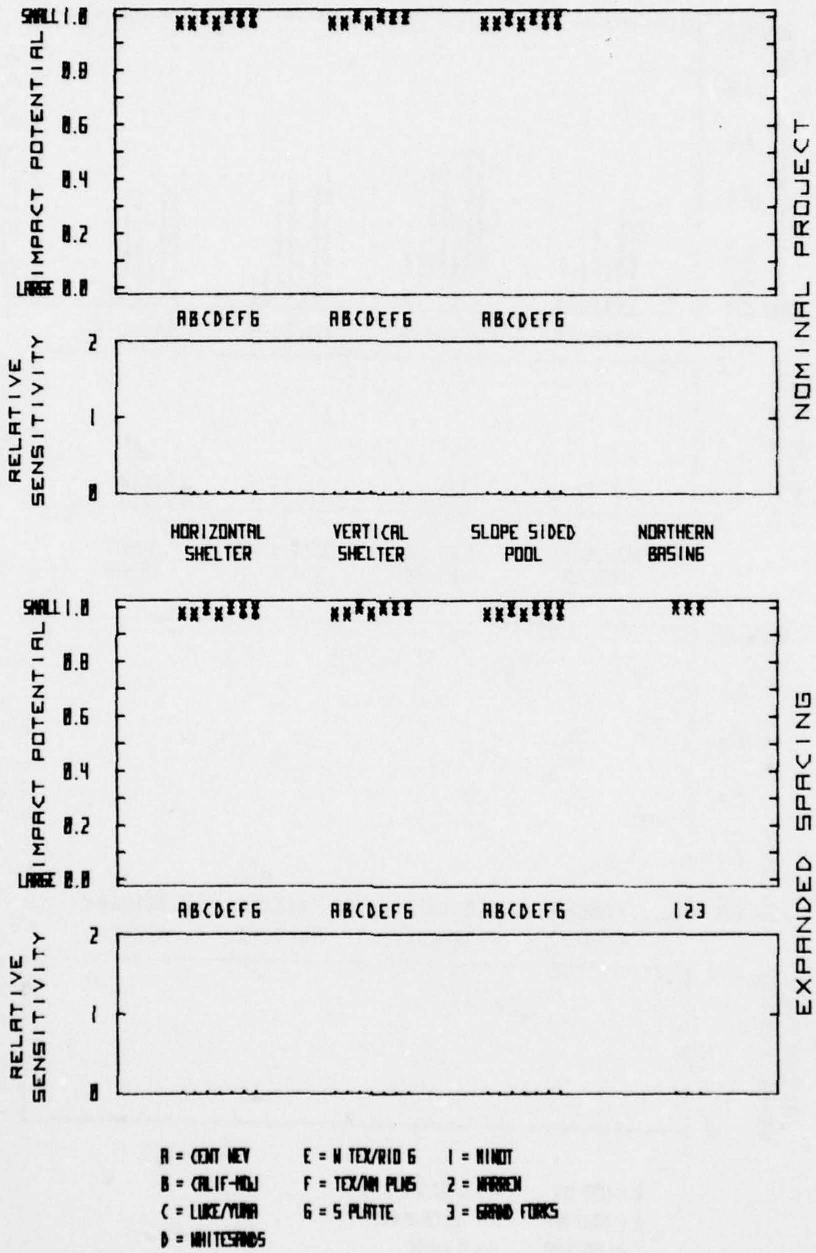


Figure A-32.

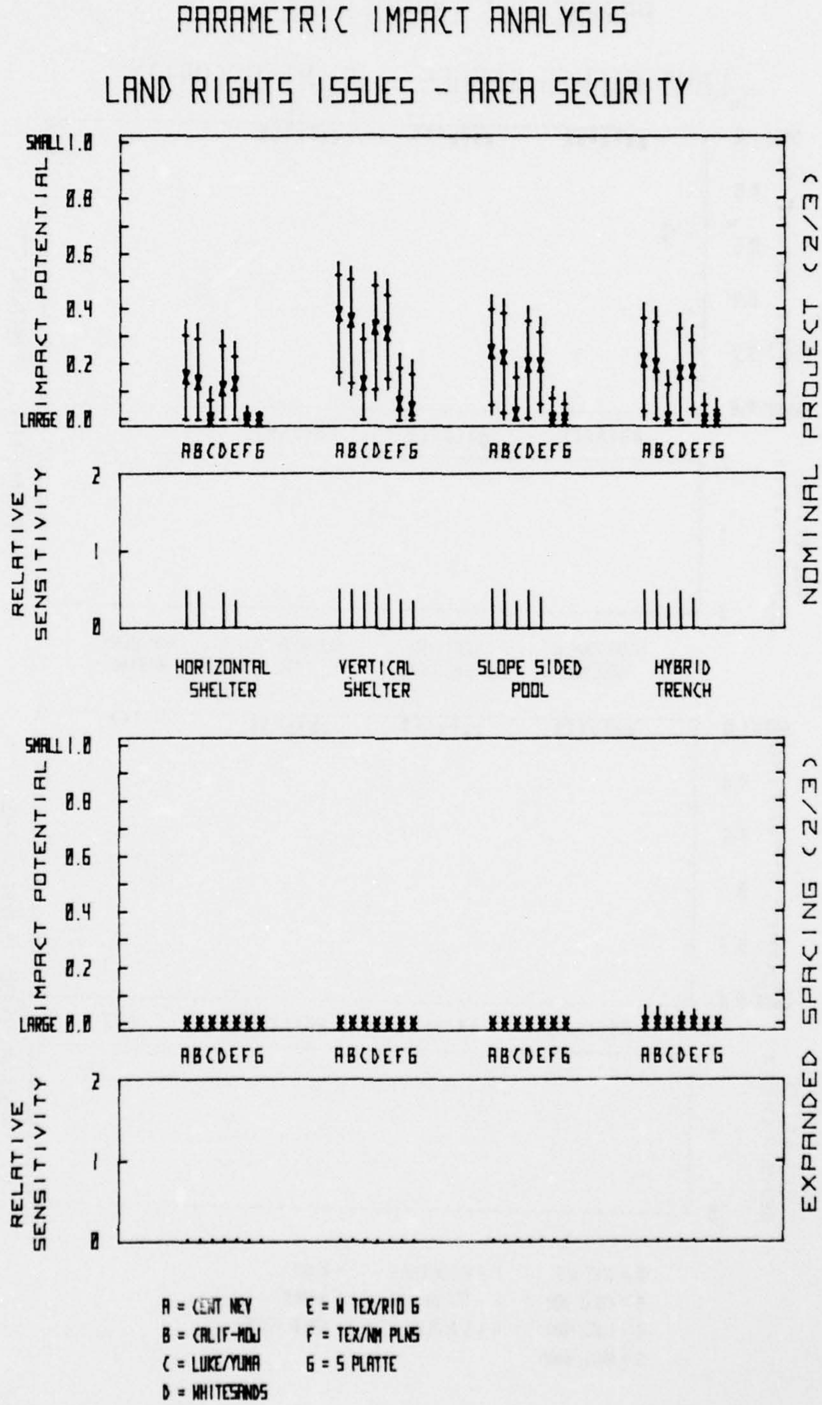
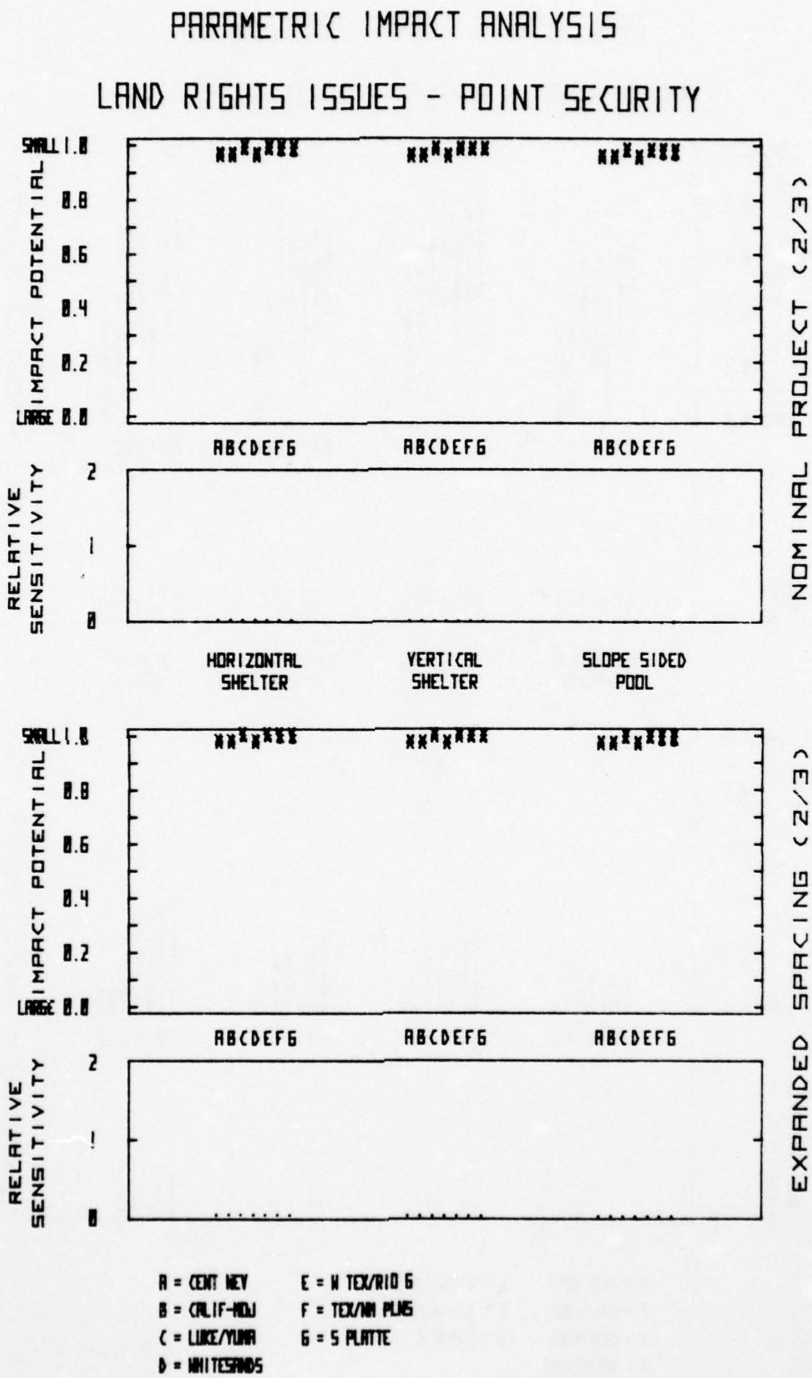
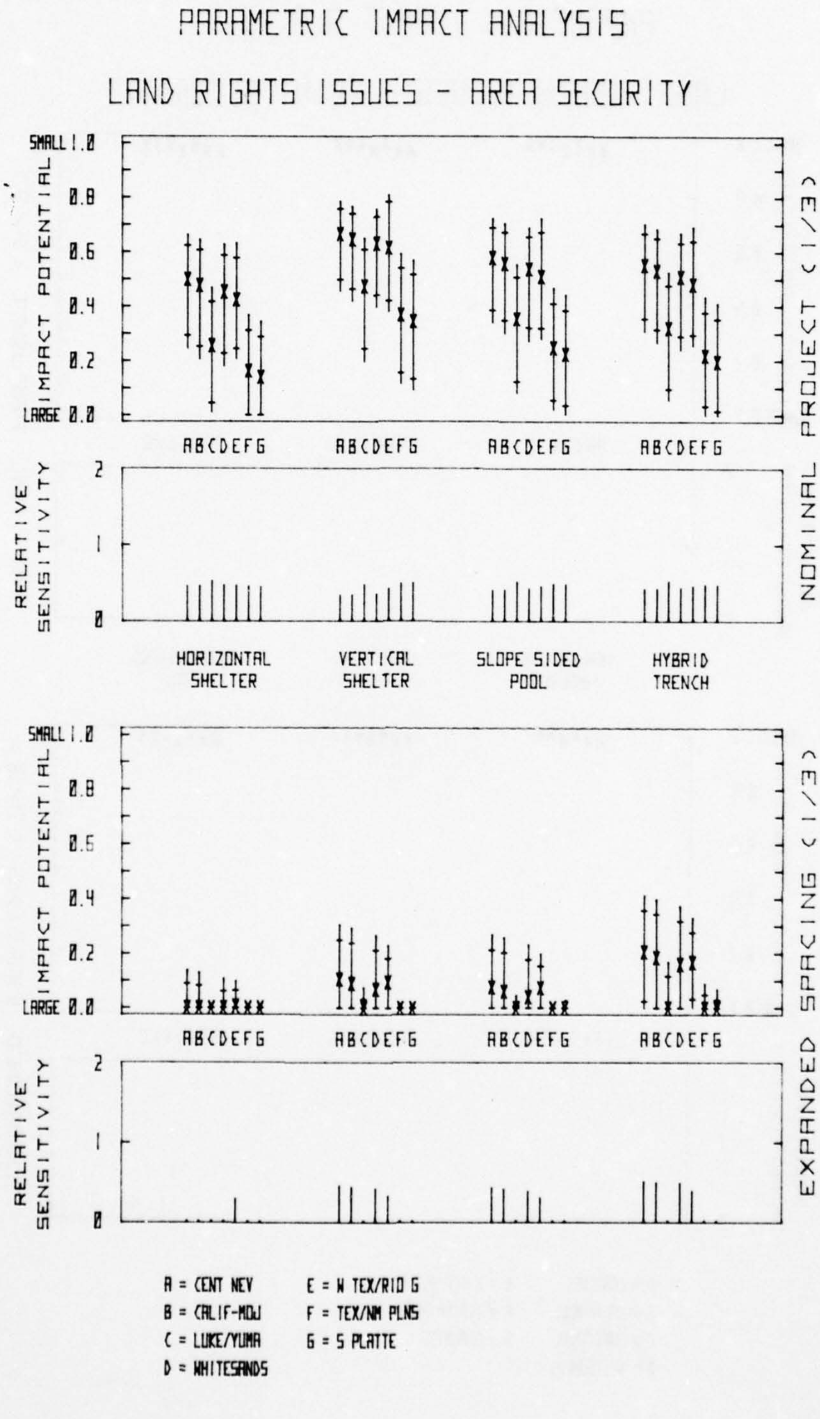

PARAMETRIC IMPACT ANALYSIS
LAND RIGHTS ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-33.



PARAMETRIC IMPACT ANALYSIS
LAND RIGHTS ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-34.



PARAMETRIC IMPACT ANALYSIS
LAND RIGHTS ISSUES - AREA SECURITY
SMALL 1.0
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0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-35.

PARAMETRIC IMPACT ANALYSIS

LAND RIGHTS ISSUES - POINT SECURITY

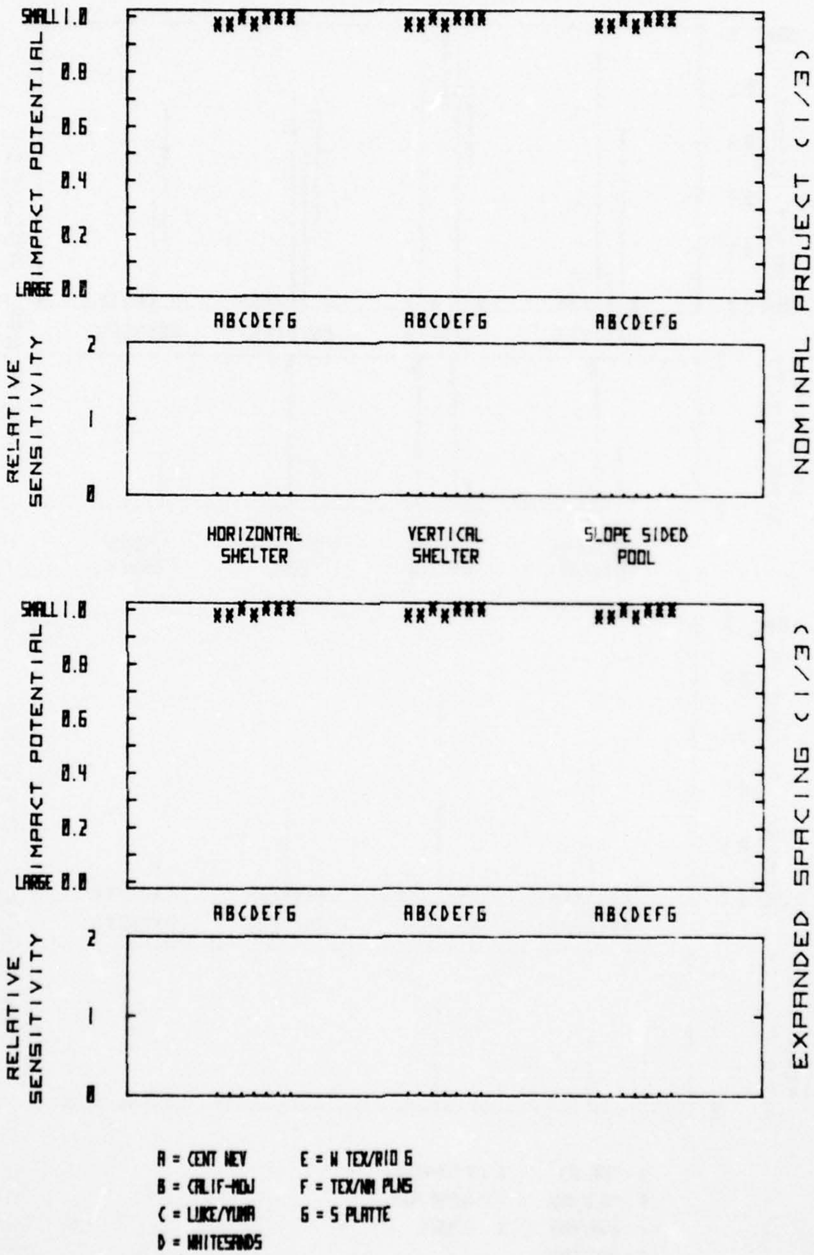
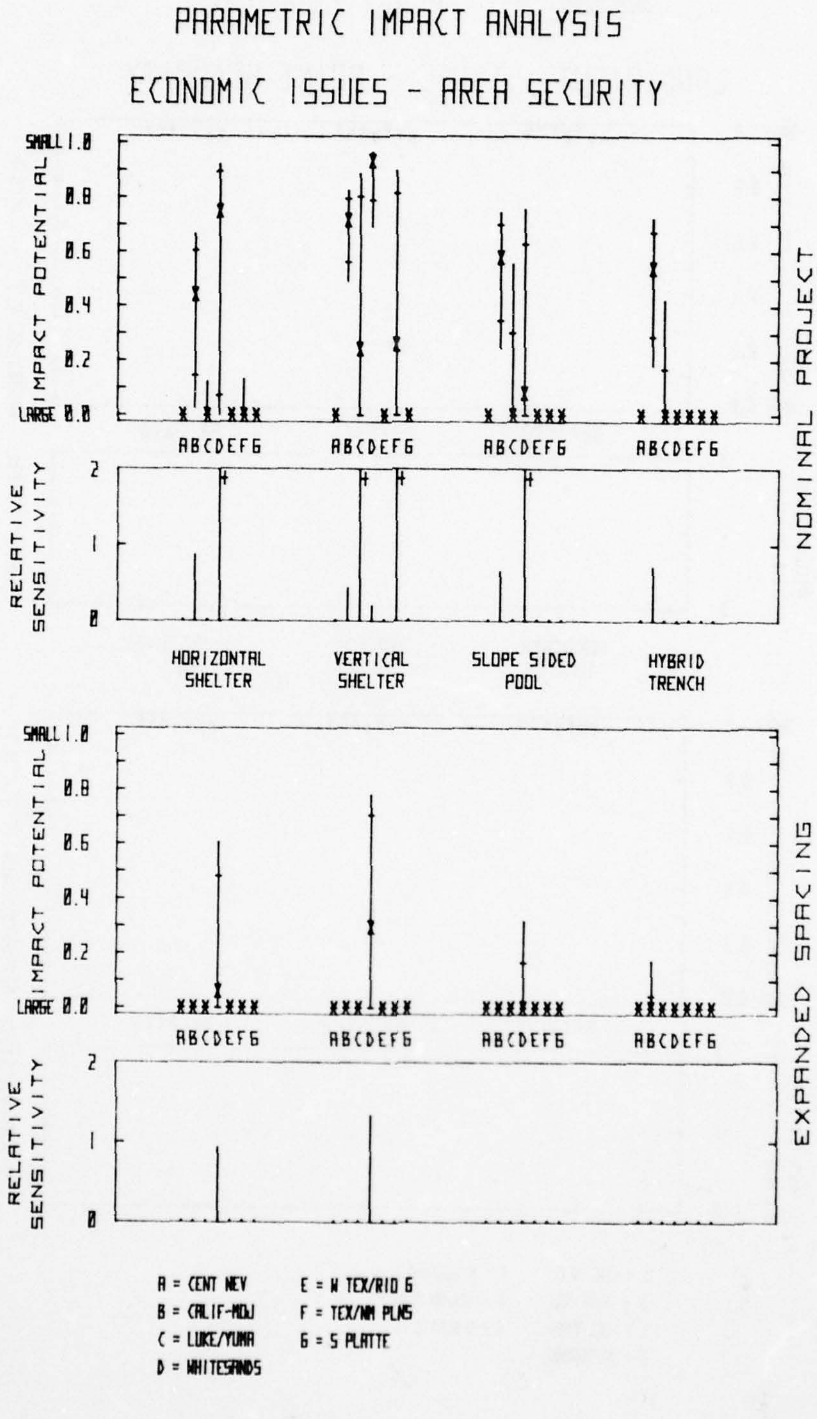
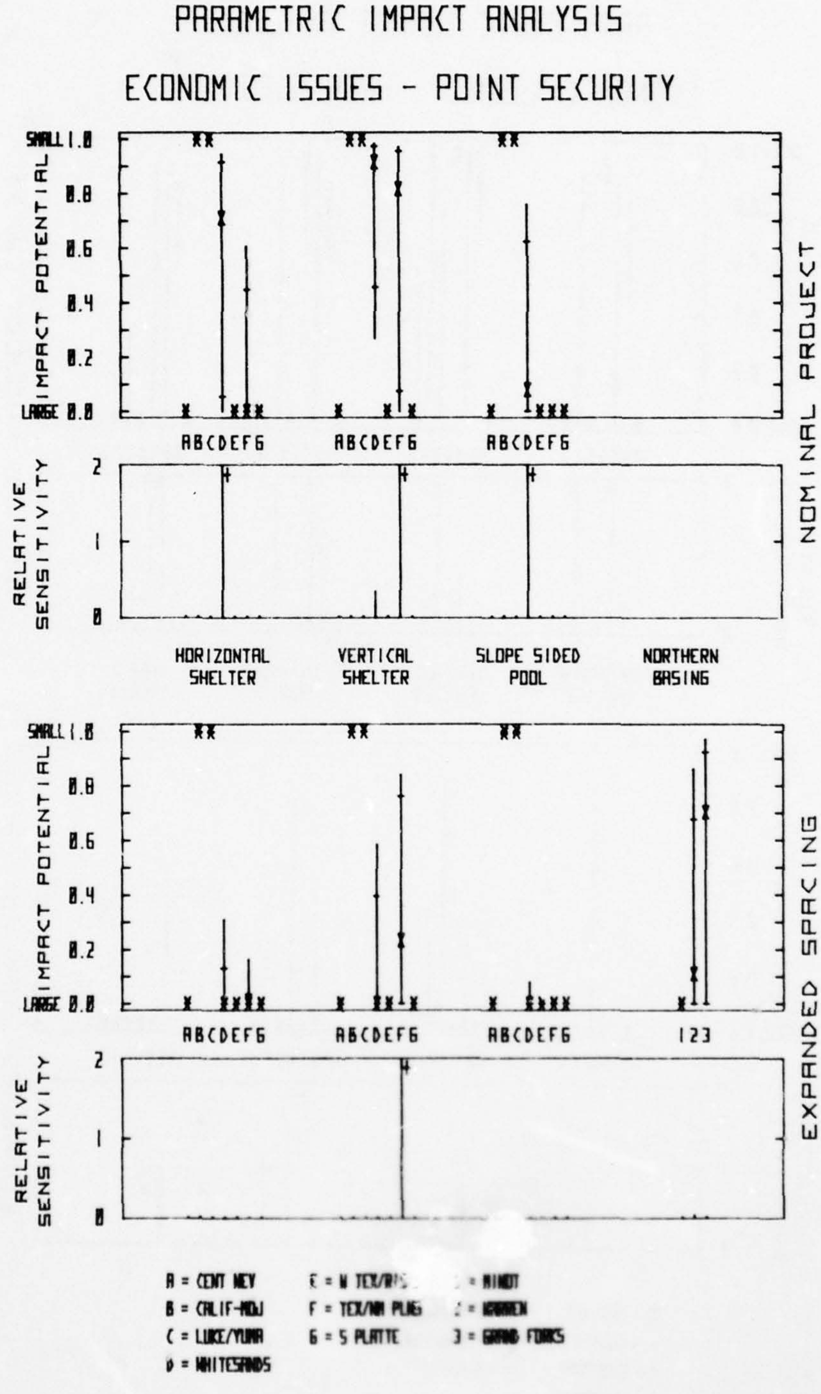


Figure A-36.



PARAMETRIC IMPACT ANALYSIS
ECONOMIC ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-37.


PARAMETRIC IMPACT ANALYSIS
ECONOMIC ISSUES - POINT SECURITY
IMPACT POTENTIAL
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0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
NOMINAL PROJECT
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
F = TEX/NM PLUG
G = S PLATTE
3 = GRAND FORKS

Figure A-38.

PARAMETRIC IMPACT ANALYSIS

ECONOMIC ISSUES - AREA SECURITY

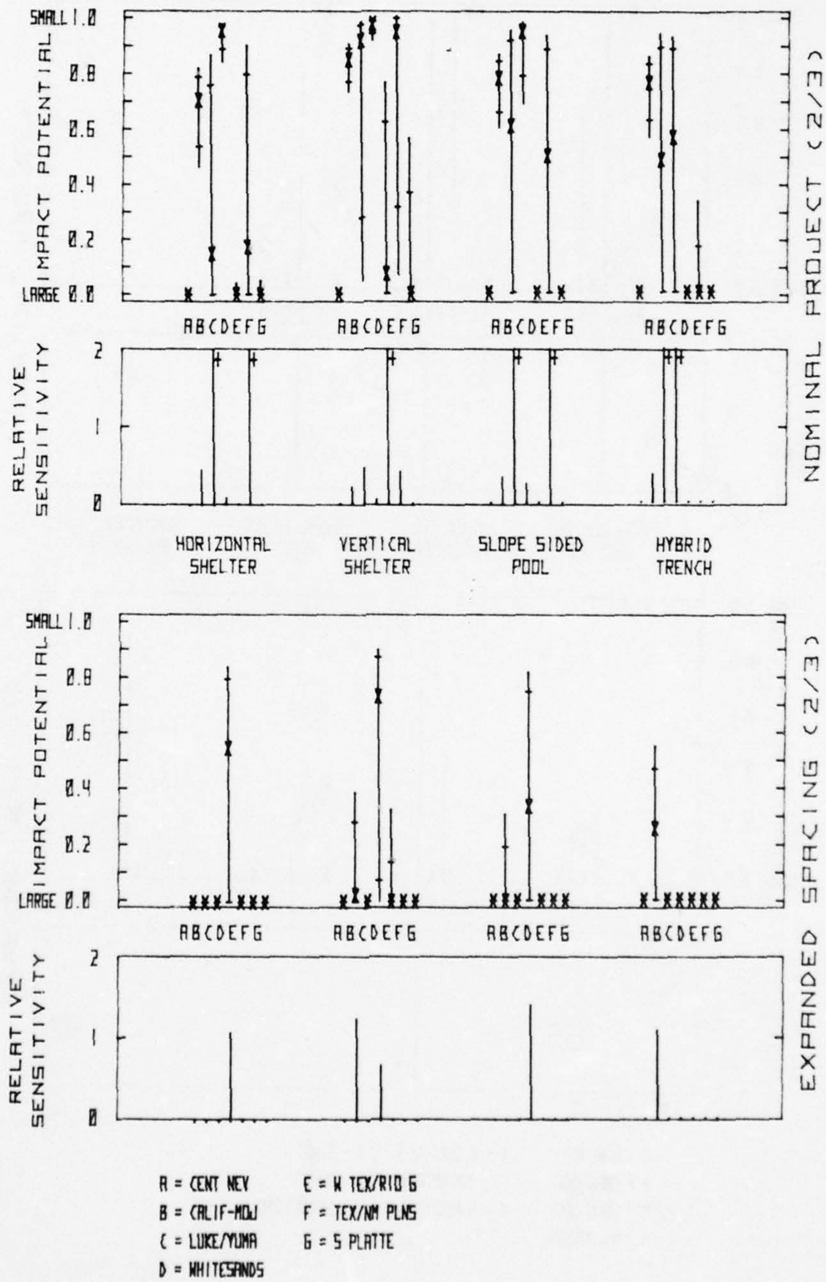

Figure A-39.

AD-A063 494 AIR FORCE SYSTEMS COMMAND WASHINGTON D C F/G 5/5
MX: MILESTONE II. FINAL ENVIRONMENTAL IMPACT STATEMENT, VOLUME --ETC(U)
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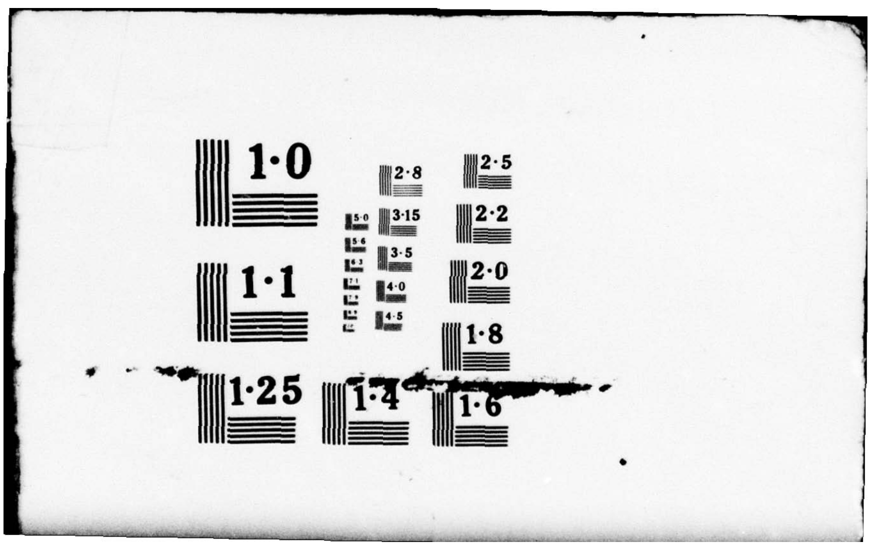
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1·1
1·8
1·25
1·4
1·6

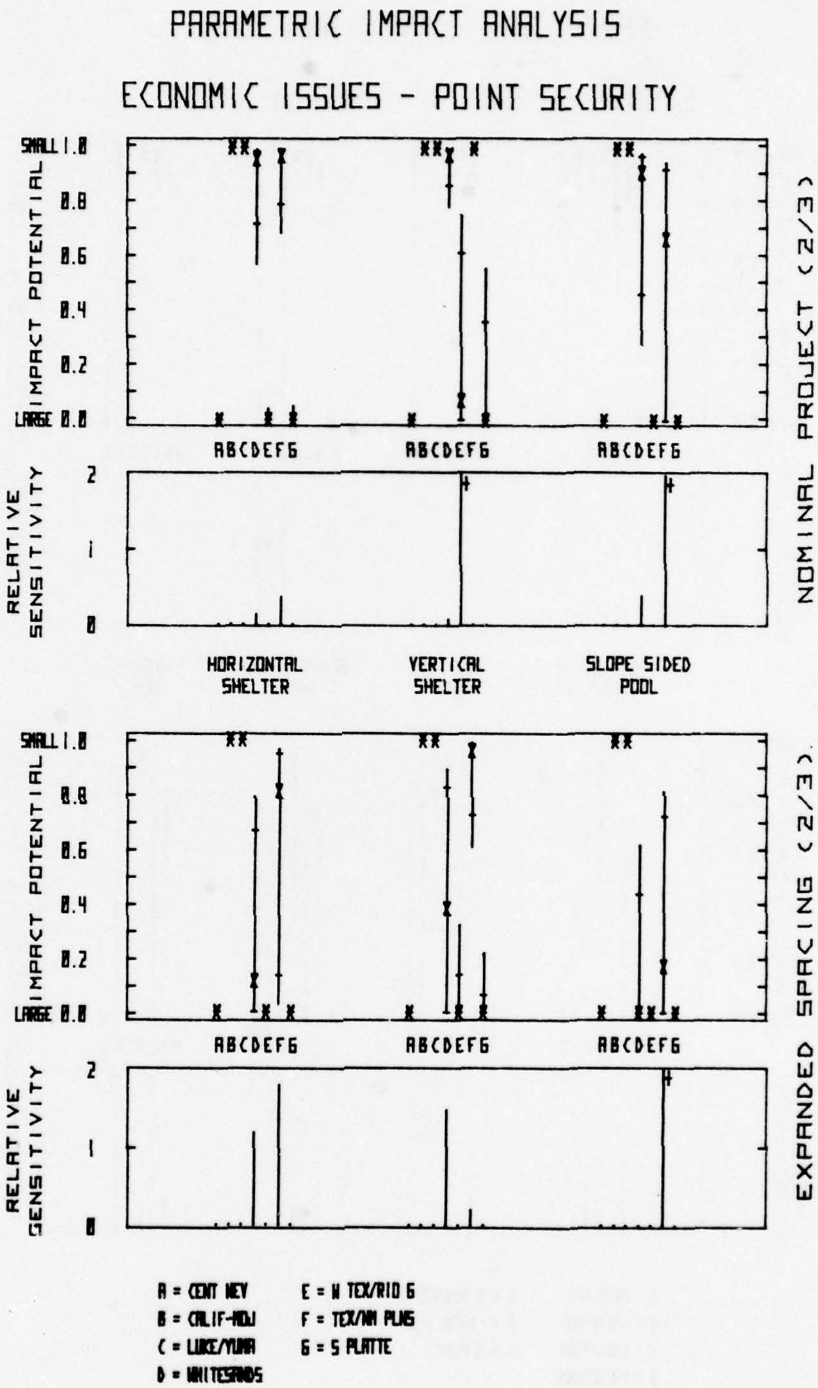

PARAMETRIC IMPACT ANALYSIS
ECONOMIC ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-40.

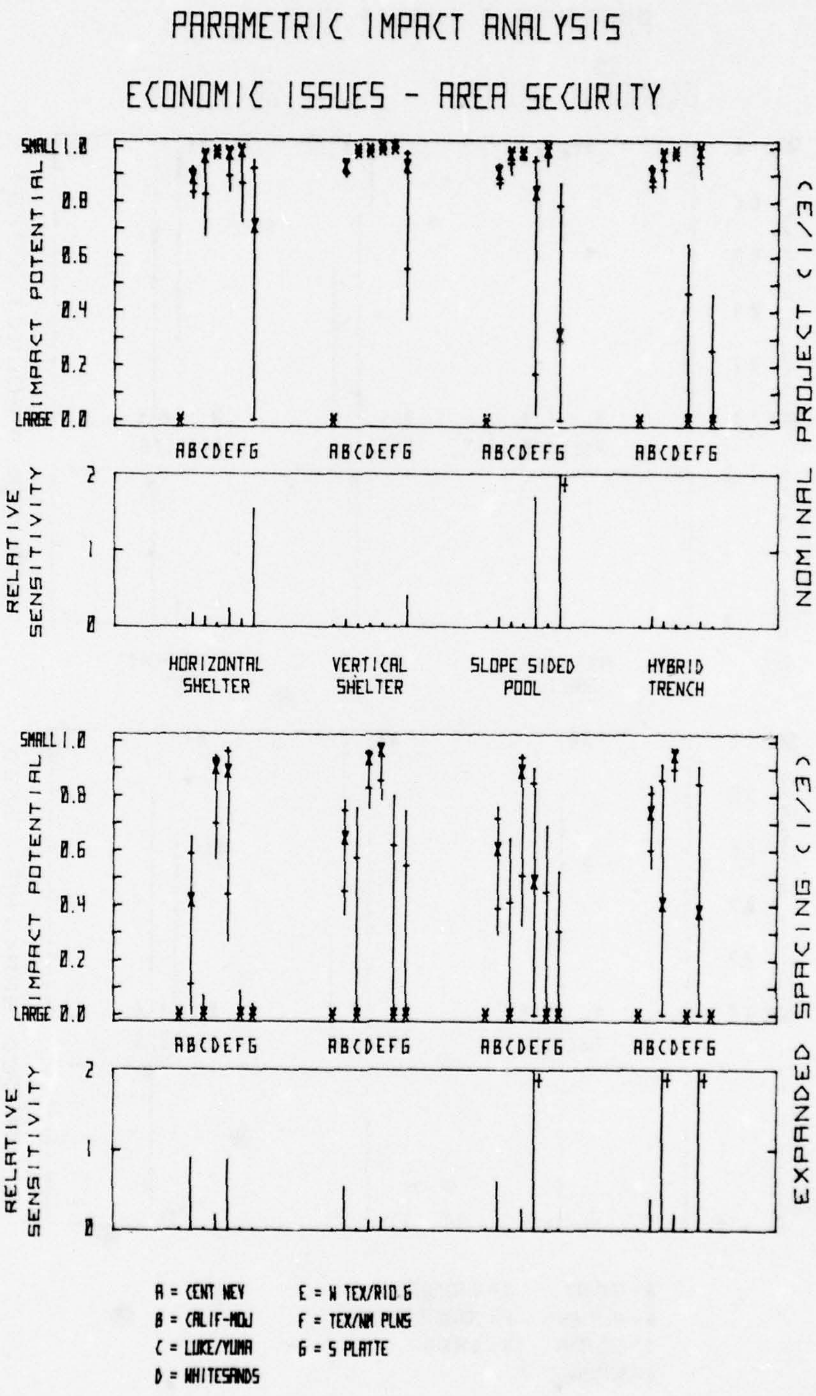

PARAMETRIC IMPACT ANALYSIS
ECONOMIC ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-41.

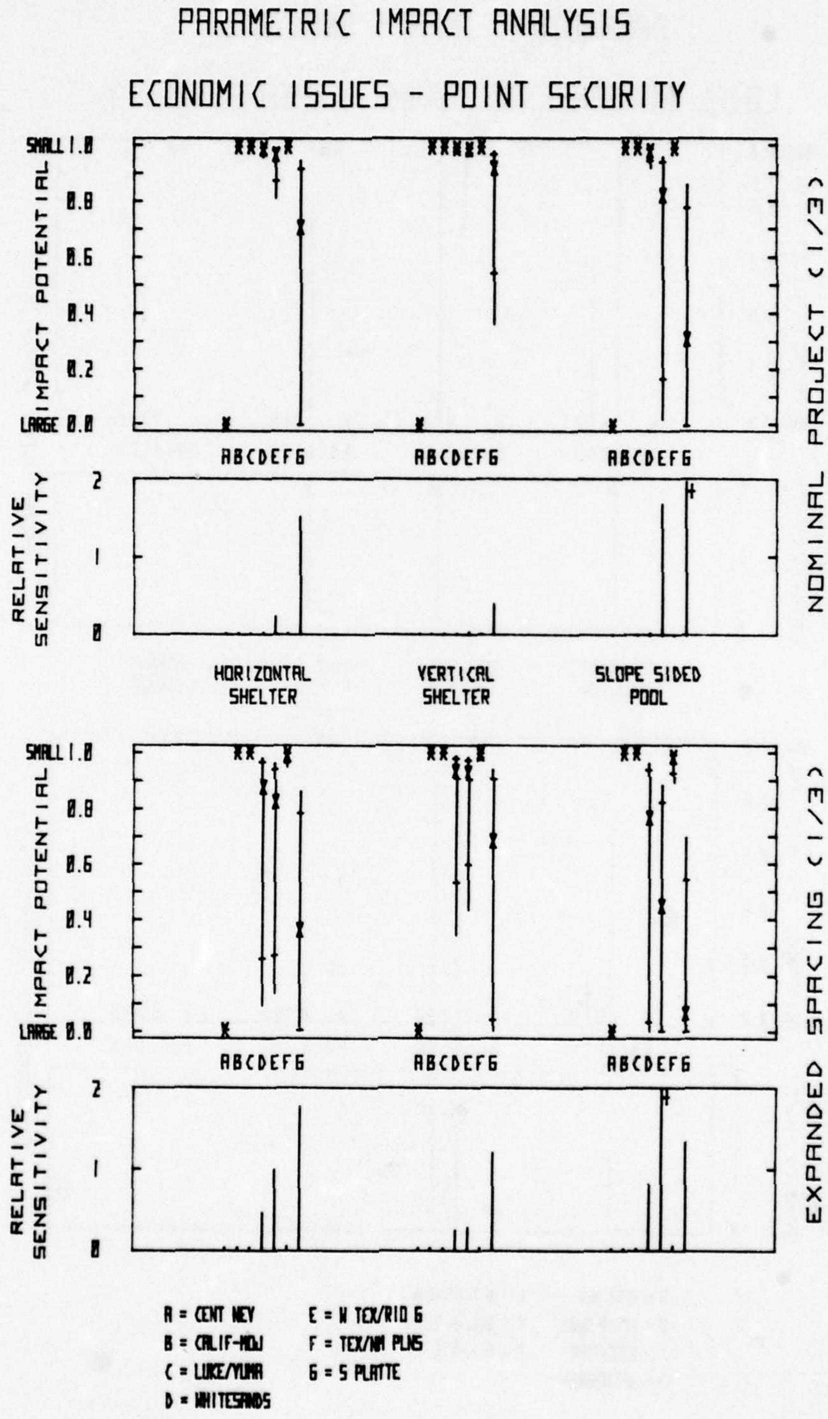

PARAMETRIC IMPACT ANALYSIS
ECONOMIC ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-42.

PARAMETRIC IMPACT ANALYSIS

LOCAL GOVERNMENT ISSUES - AREA SECURITY

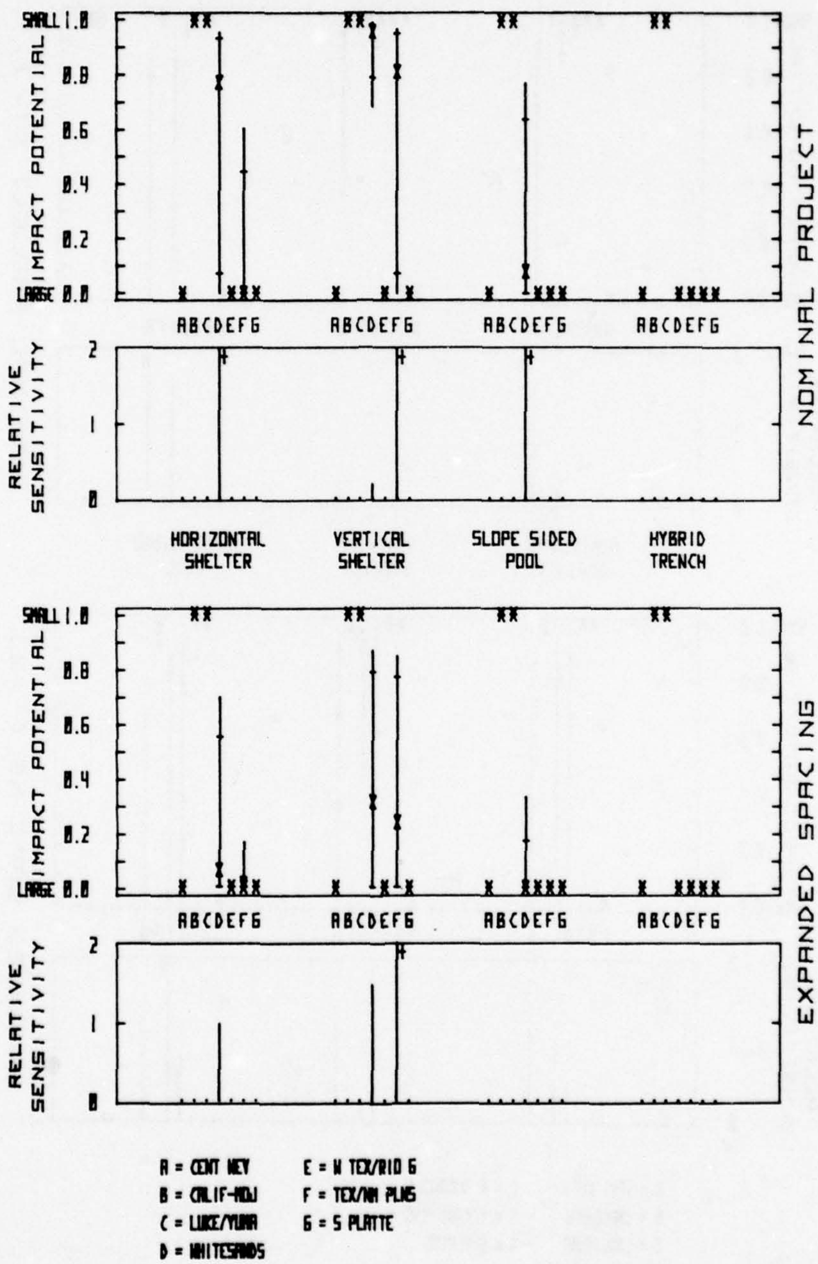


Figure A-43.

PARAMETRIC IMPACT ANALYSIS

LOCAL GOVERNMENT ISSUES - POINT SECURITY

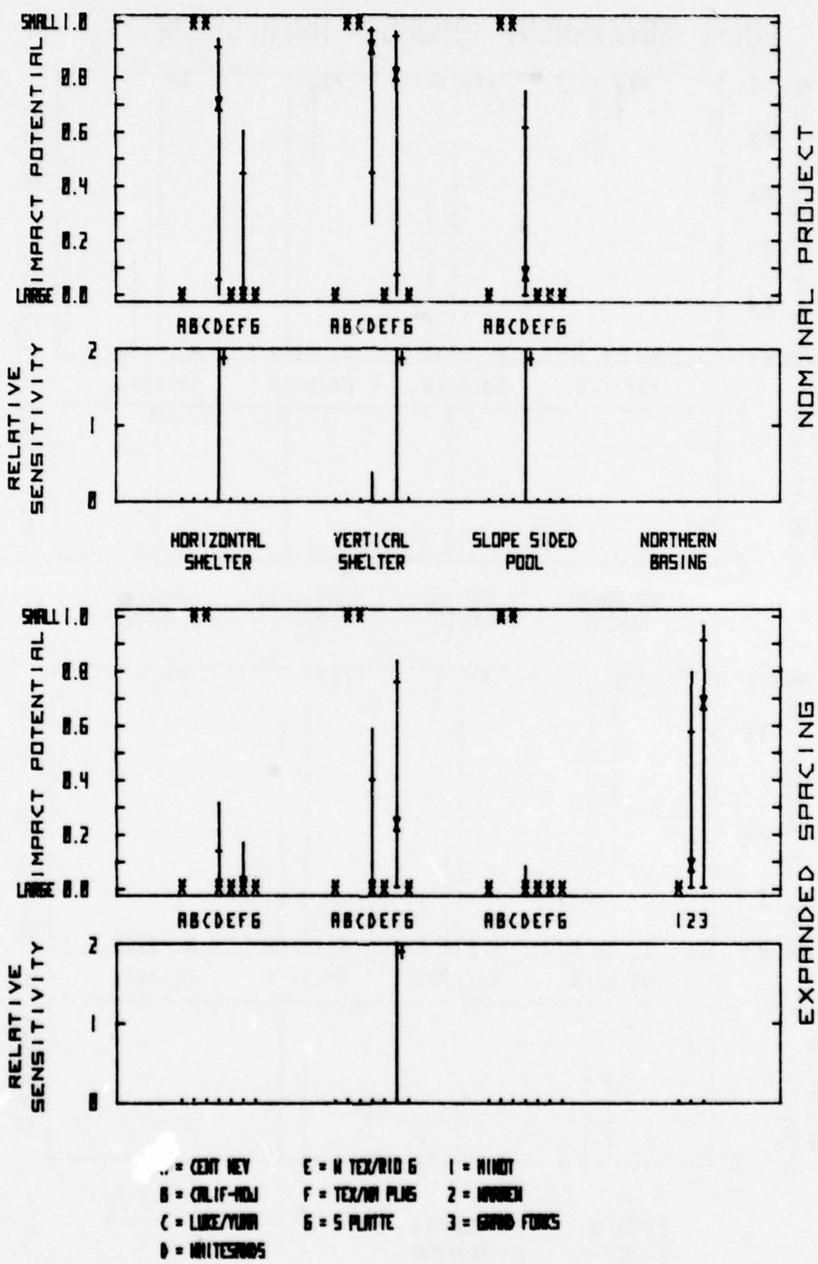


Figure A-44.

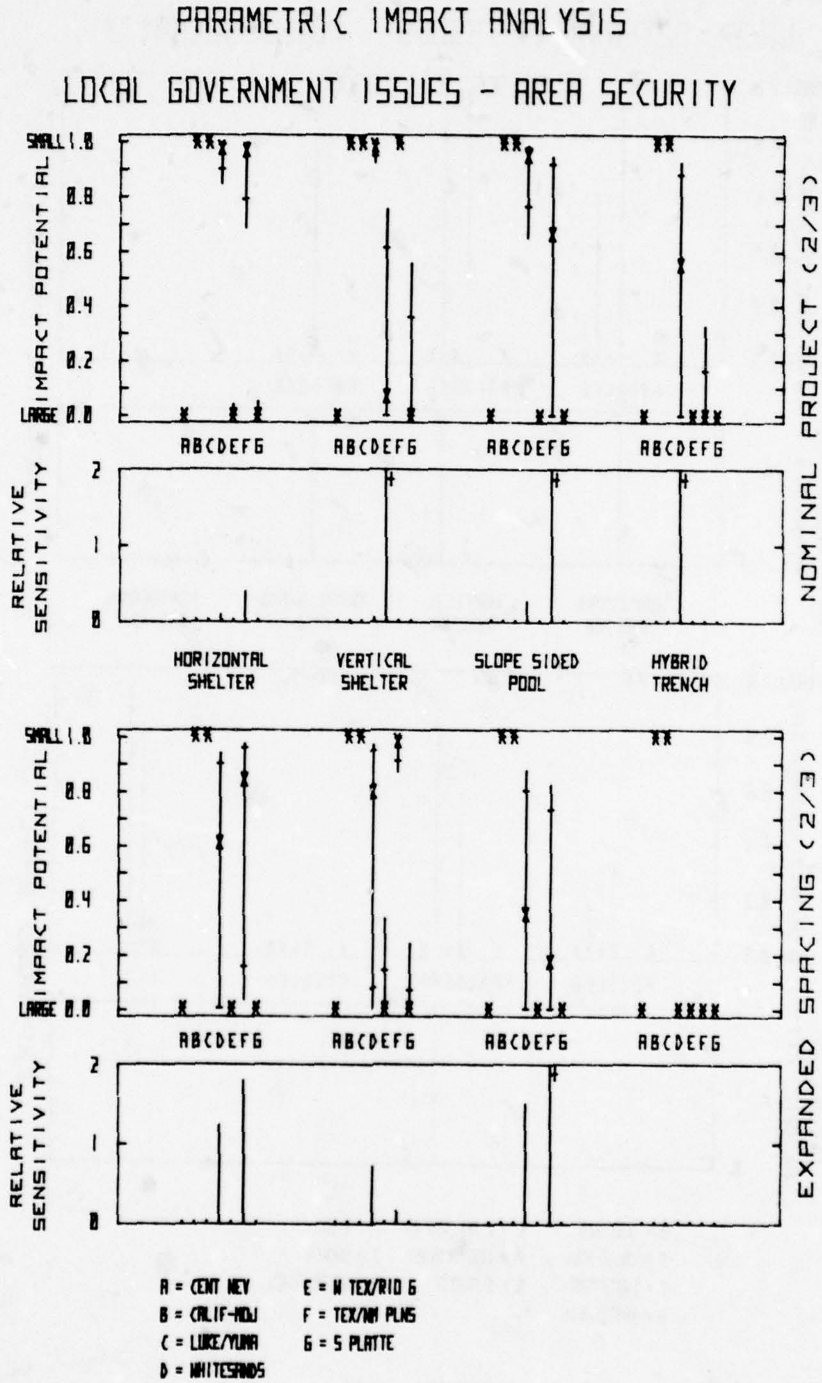

PARAMETRIC IMPACT ANALYSIS
LOCAL GOVERNMENT ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-45.

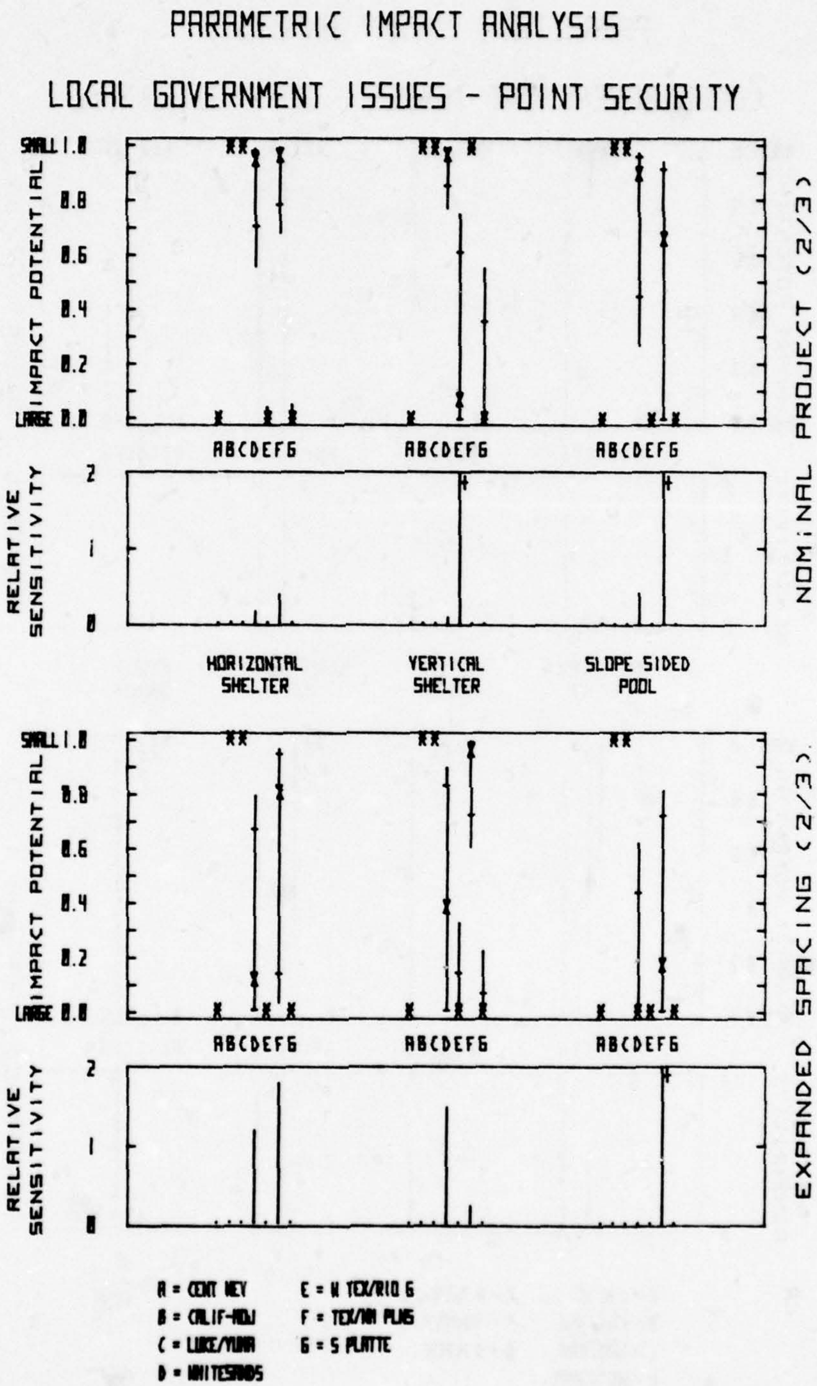

PARAMETRIC IMPACT ANALYSIS
LOCAL GOVERNMENT ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-46.

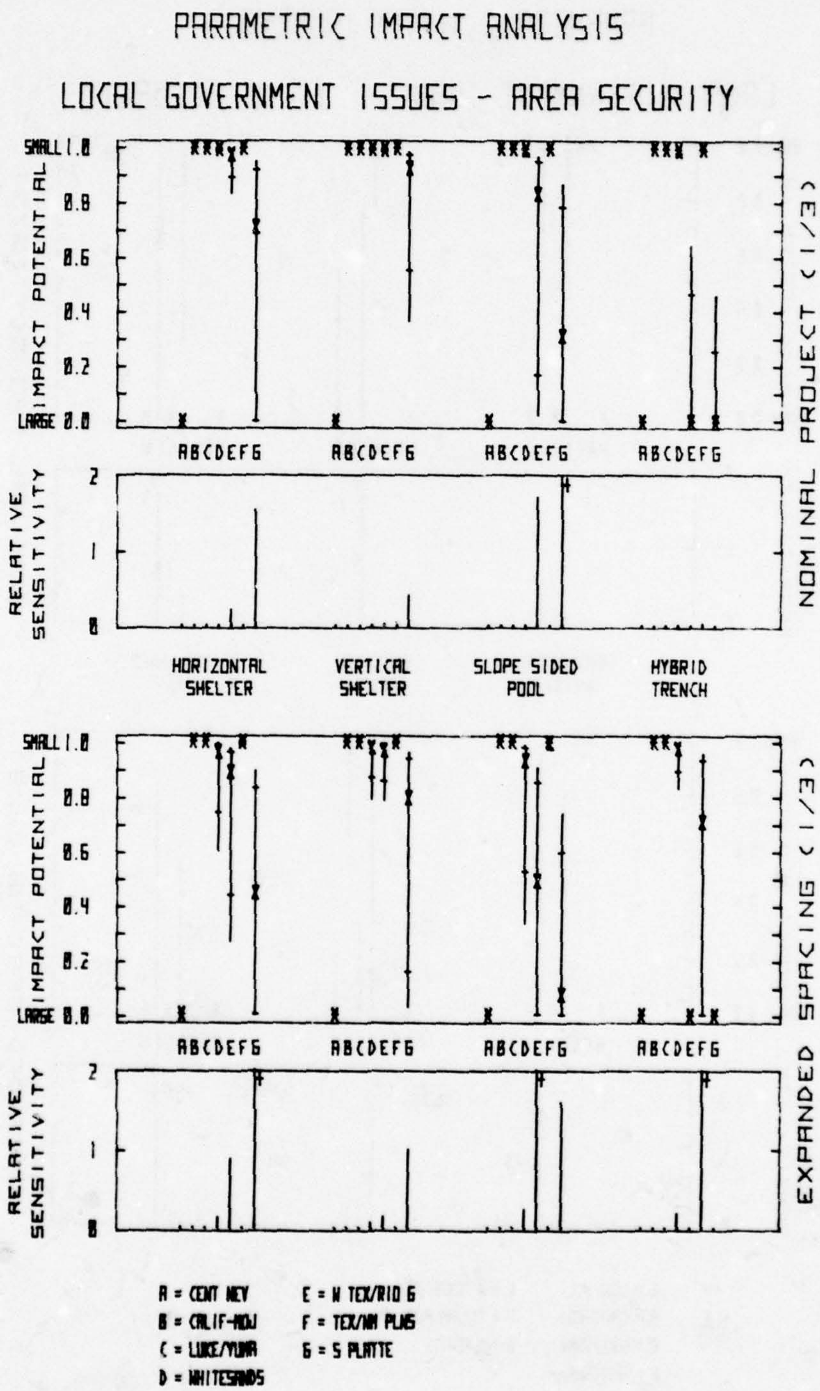

PARAMETRIC IMPACT ANALYSIS
LOCAL GOVERNMENT ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-47.

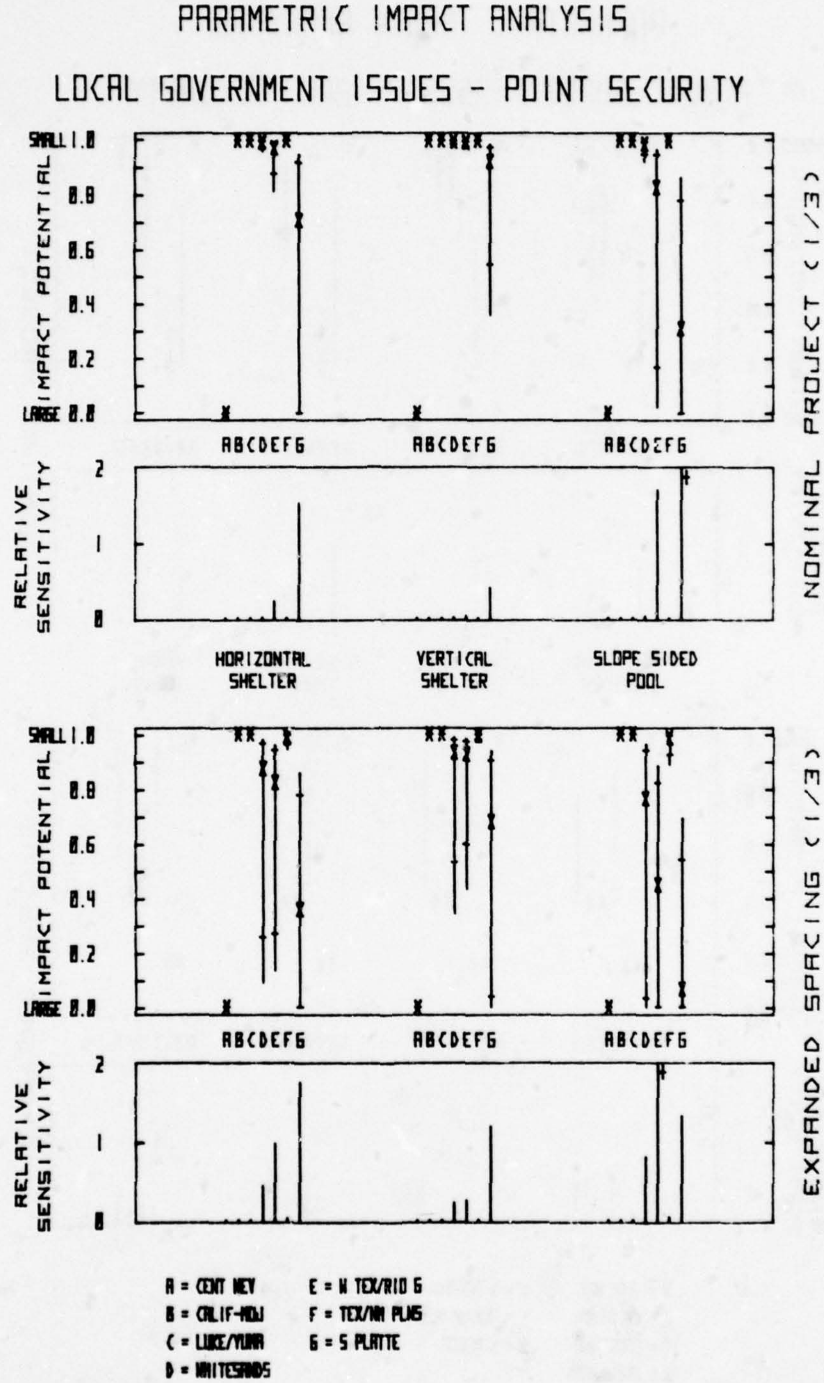

PARAMETRIC IMPACT ANALYSIS
LOCAL GOVERNMENT ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-48.

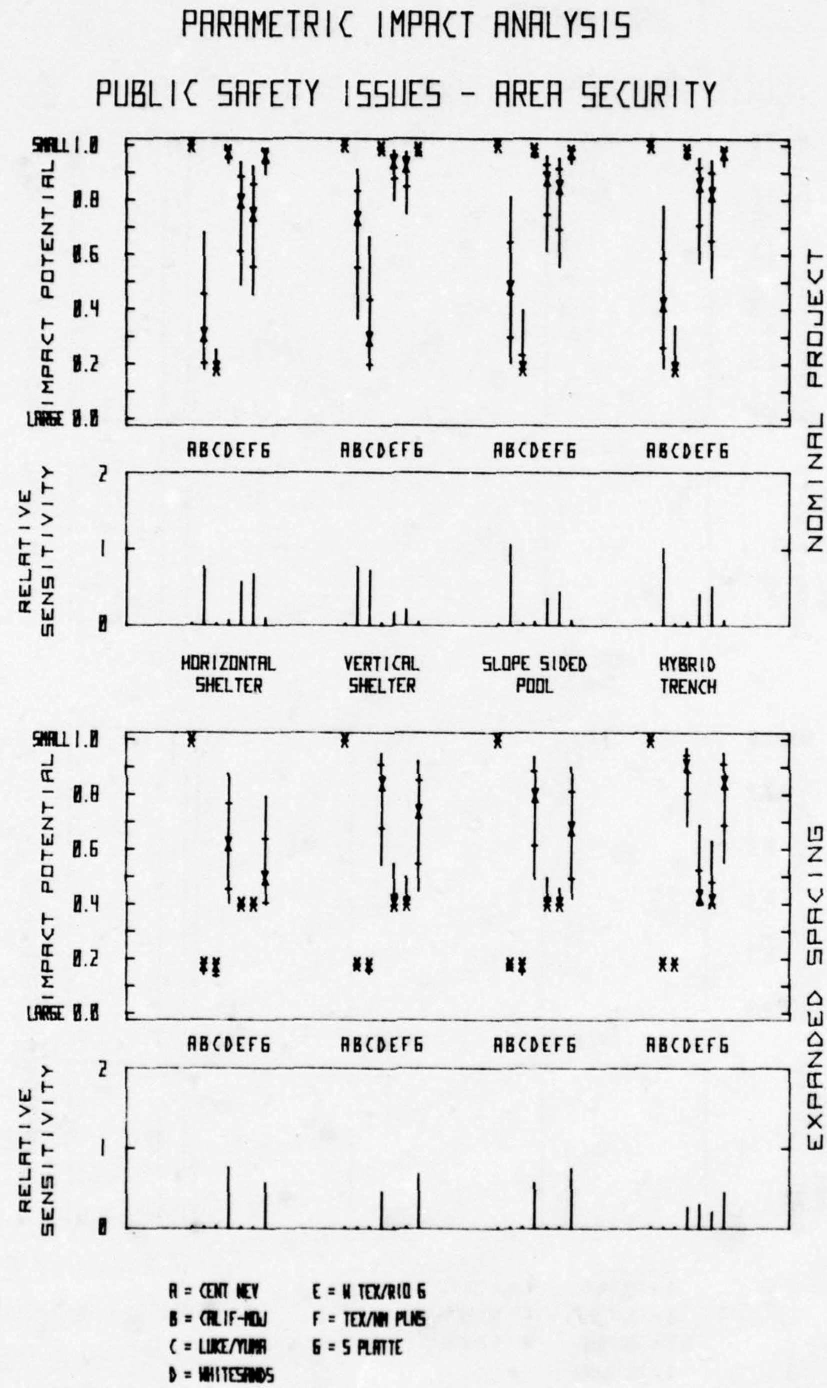

PARAMETRIC IMPACT ANALYSIS
PUBLIC SAFETY ISSUES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-49.

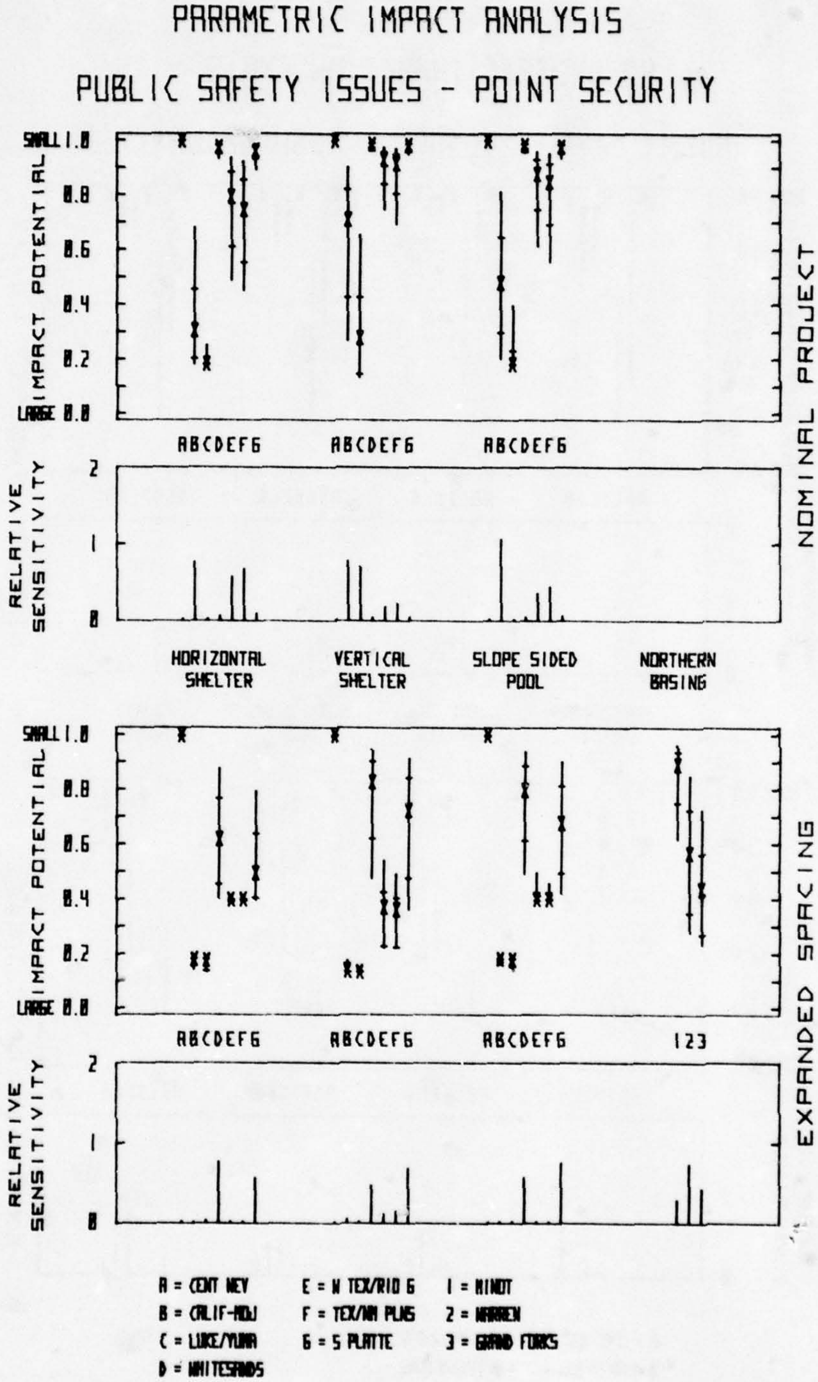
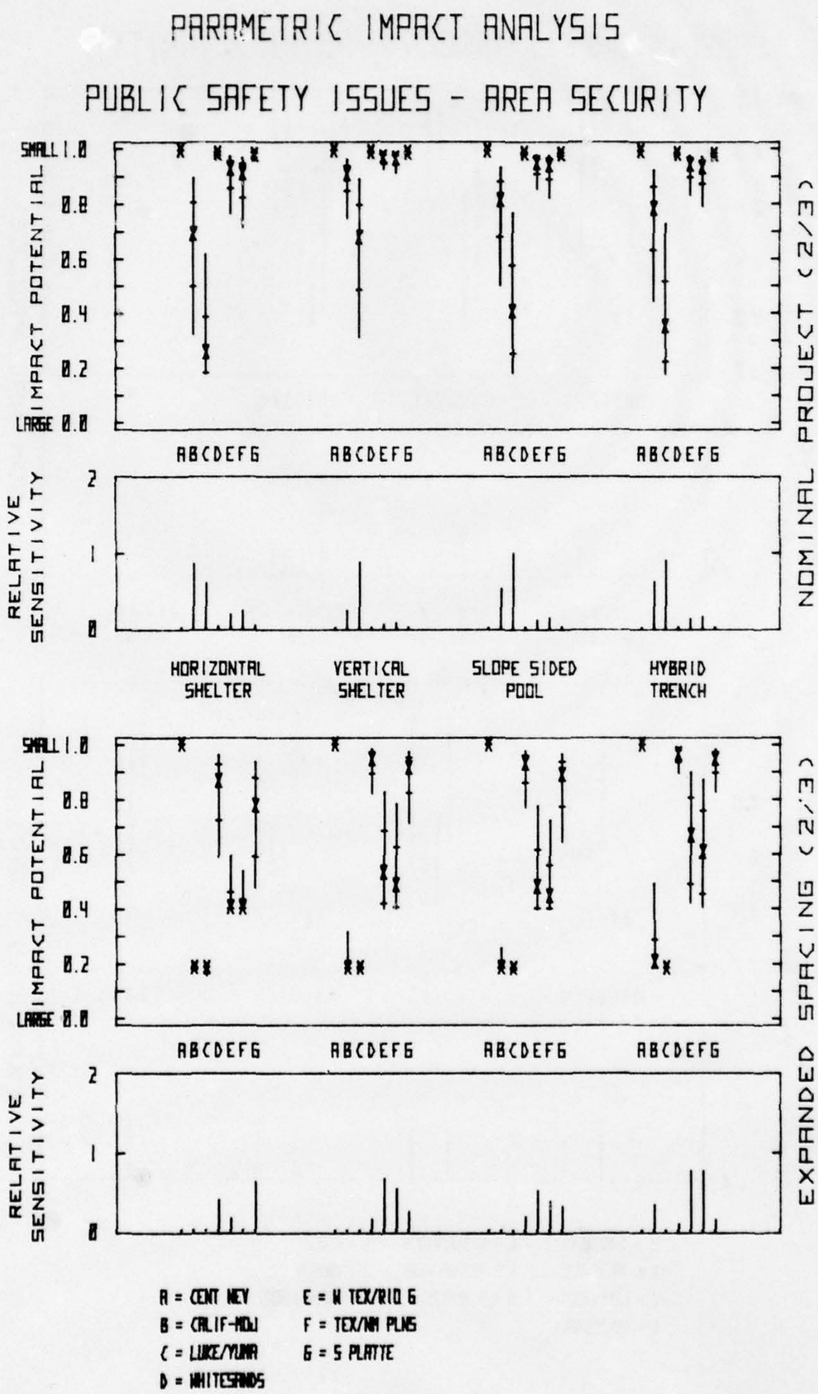

PARAMETRIC IMPACT ANALYSIS
PUBLIC SAFETY ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG ABCDEFG ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-50.



PARAMETRIC IMPACT ANALYSIS
PUBLIC SAFETY ISSUES - AREA SECURITY
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0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG ABCDEFG ABCDEFG ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-51.

PARAMETRIC IMPACT ANALYSIS

PUBLIC SAFETY ISSUES - POINT SECURITY

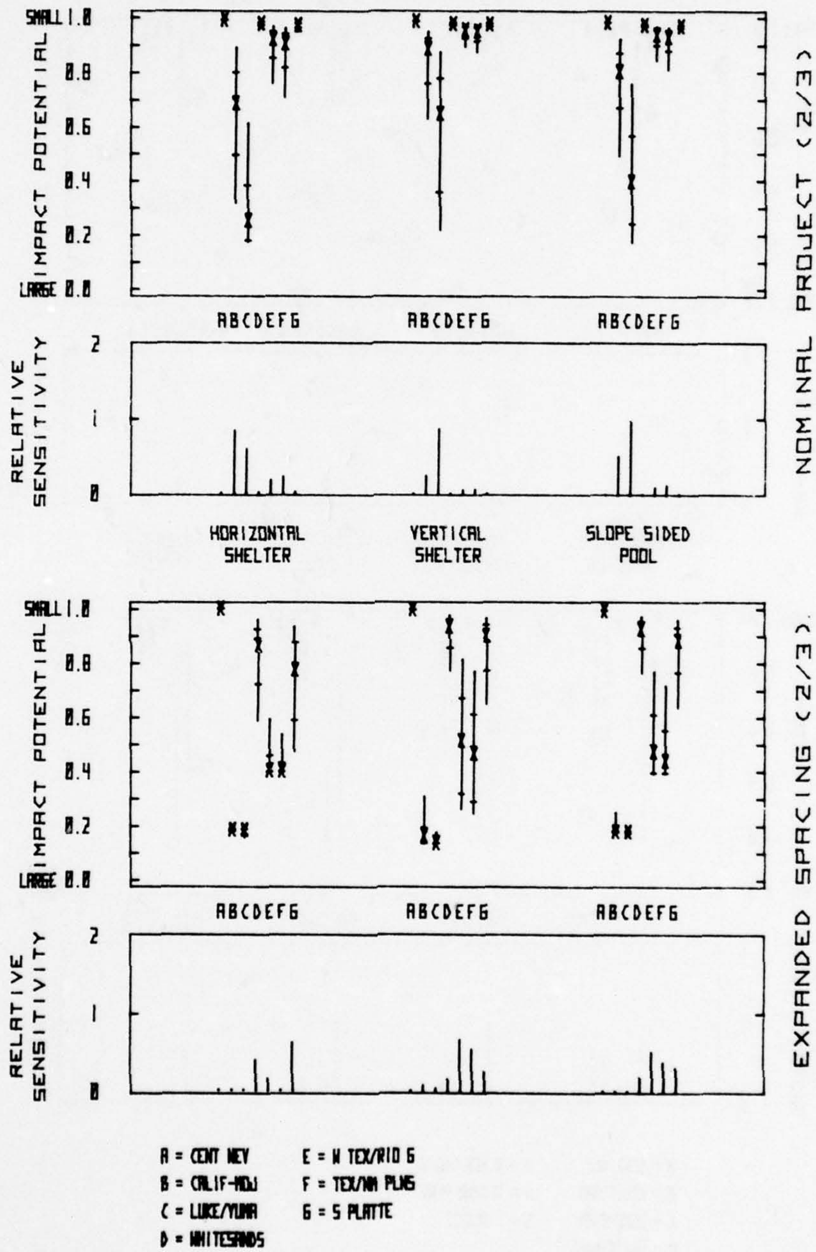


Figure A-52.

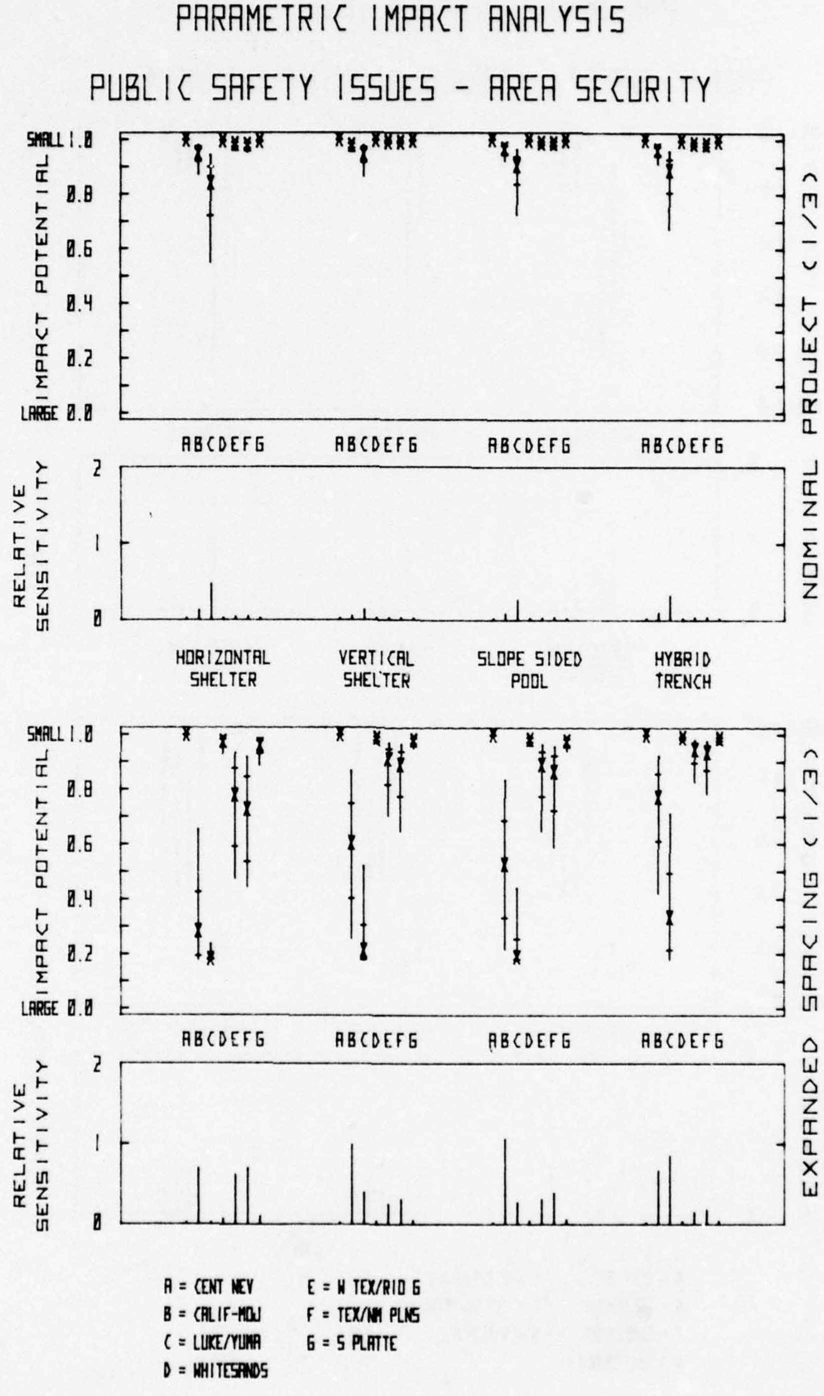
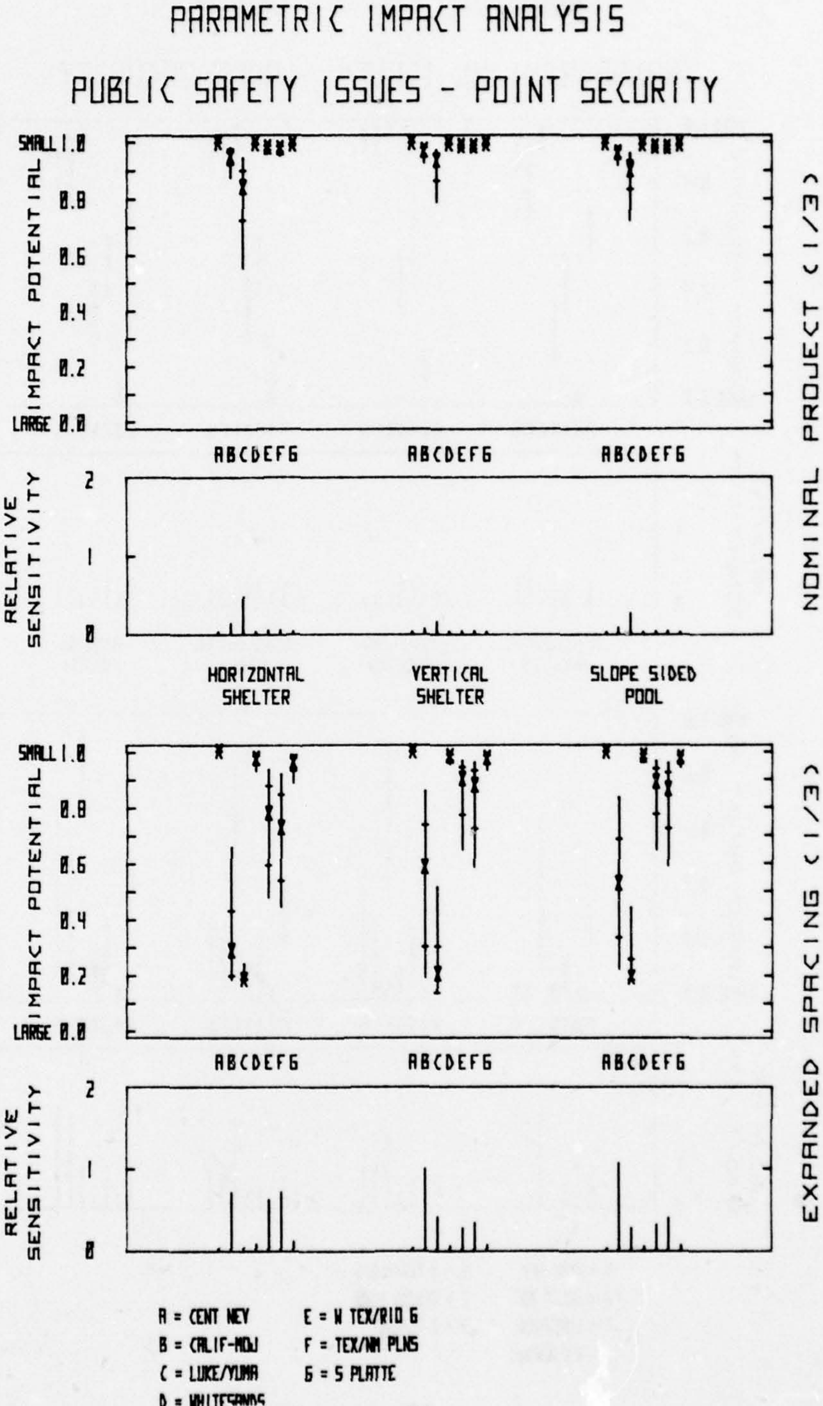
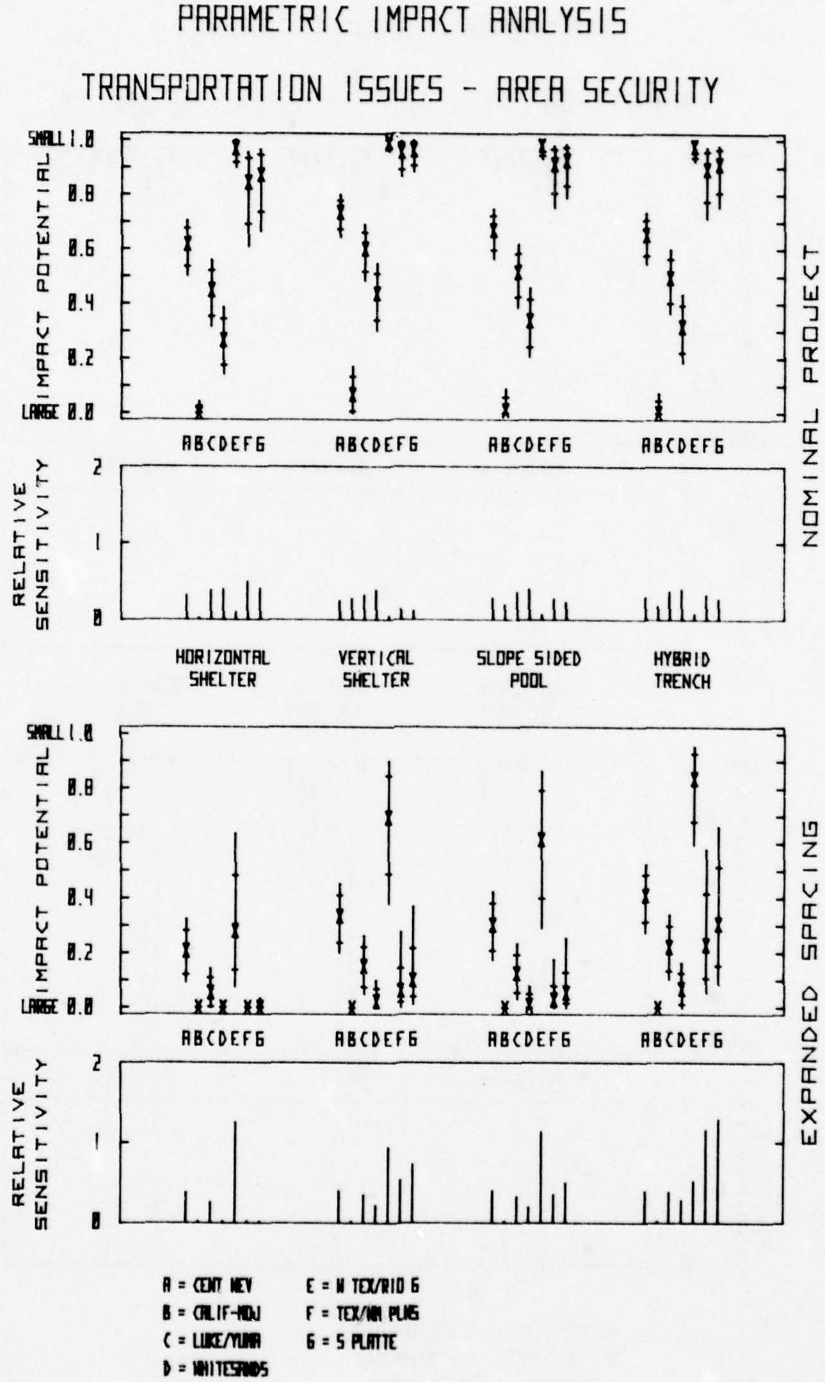

PARAMETRIC IMPACT ANALYSIS
PUBLIC SAFETY ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG ABCDEFG ABCDEFG ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-53.



PARAMETRIC IMPACT ANALYSIS
PUBLIC SAFETY ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-54.


PARAMETRIC IMPACT ANALYSIS
TRANSPORTATION ISSUES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
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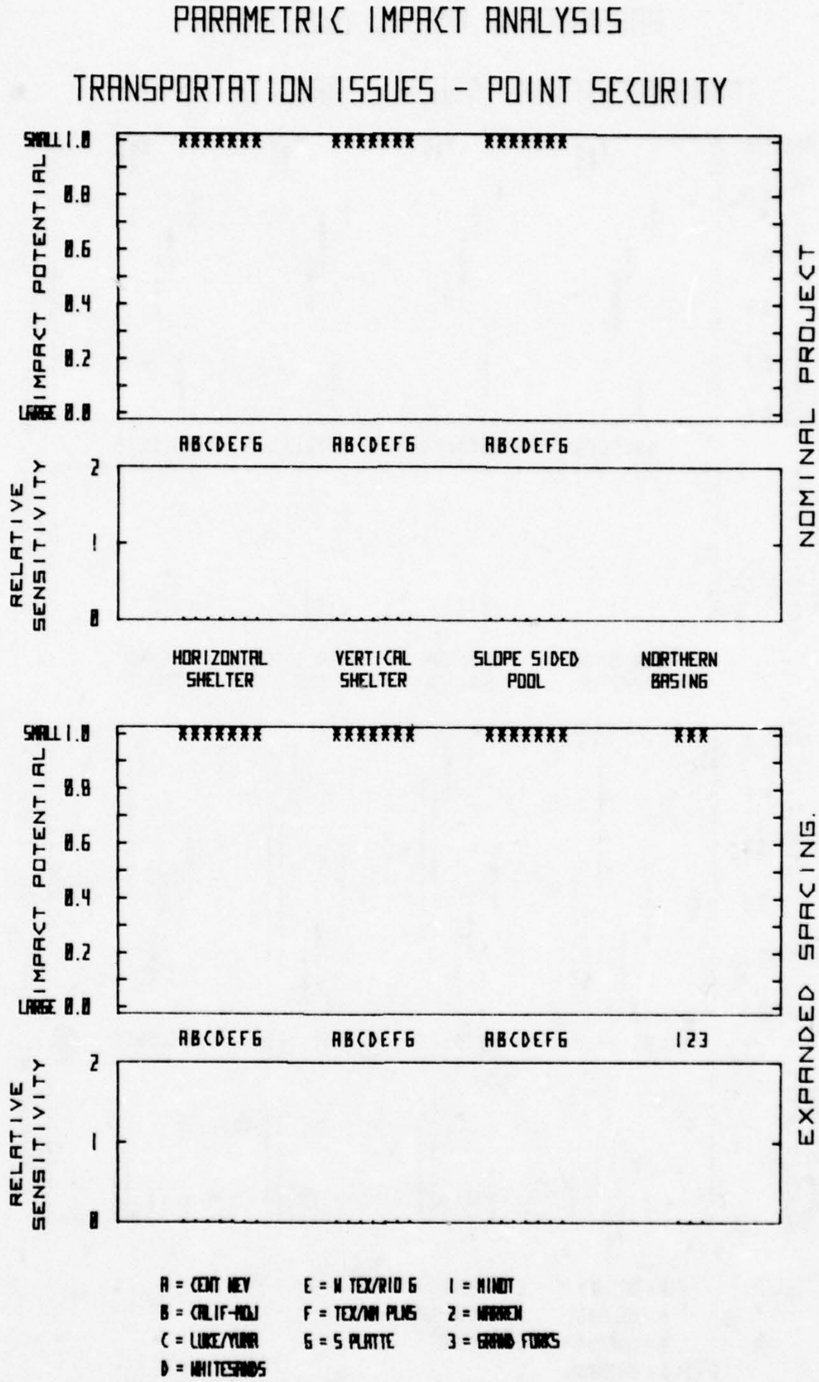
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-NDJ
C = LUKE/YUMA
D = WHITESANDS
E = N TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-55.


PARAMETRIC IMPACT ANALYSIS
TRANSPORTATION ISSUES - POINT SECURITY
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0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG ABCDEFG ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
ABCDEFG ABCDEFG ABCDEFG 123
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-56.

PARAMETRIC IMPACT ANALYSIS

TRANSPORTATION ISSUES - AREA SECURITY

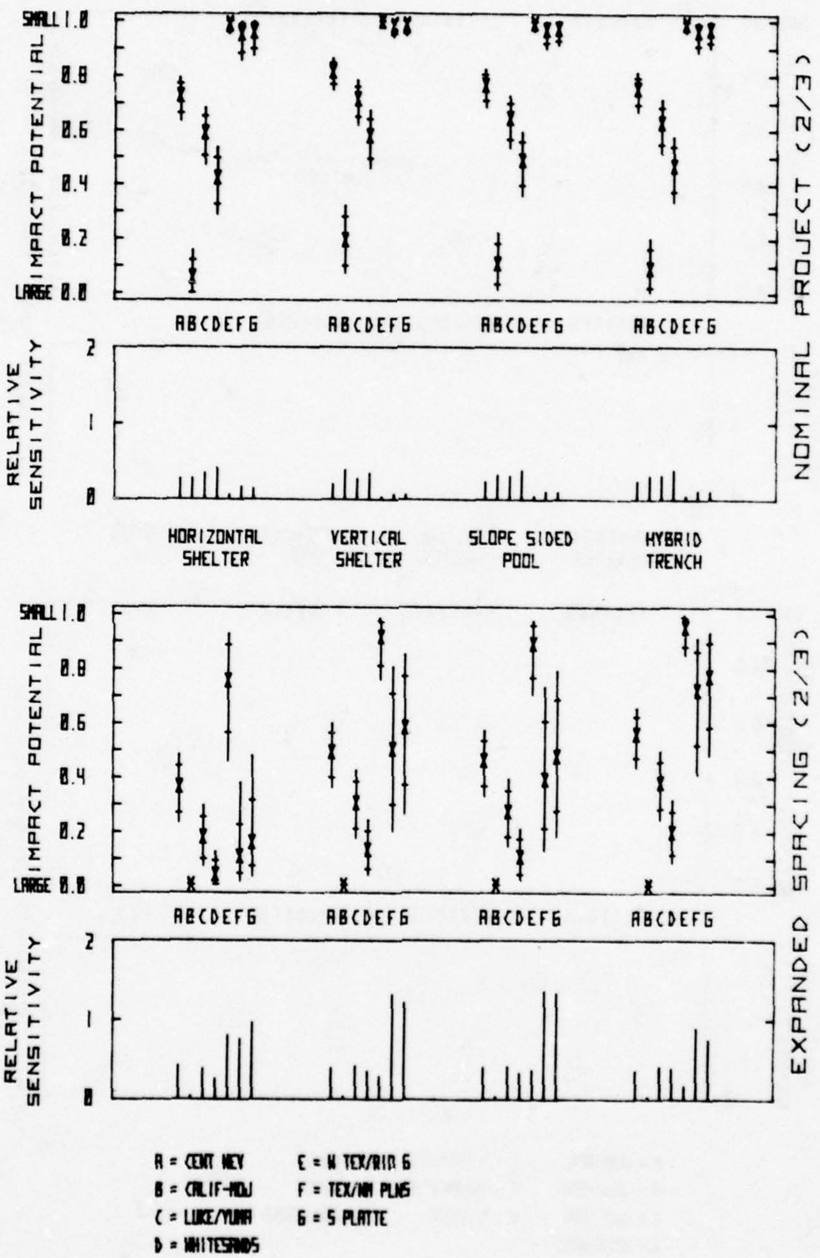


Figure A-57.

PARAMETRIC IMPACT ANALYSIS

TRANSPORTATION ISSUES - POINT SECURITY

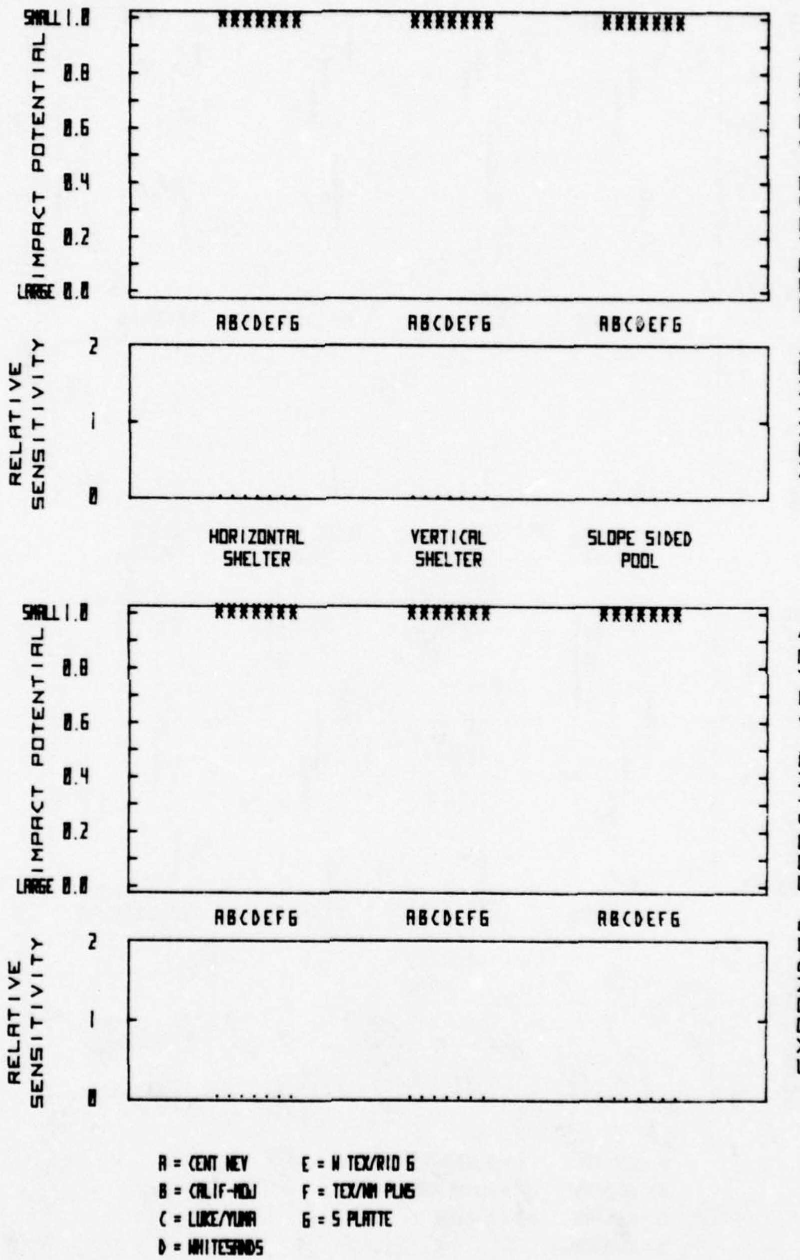
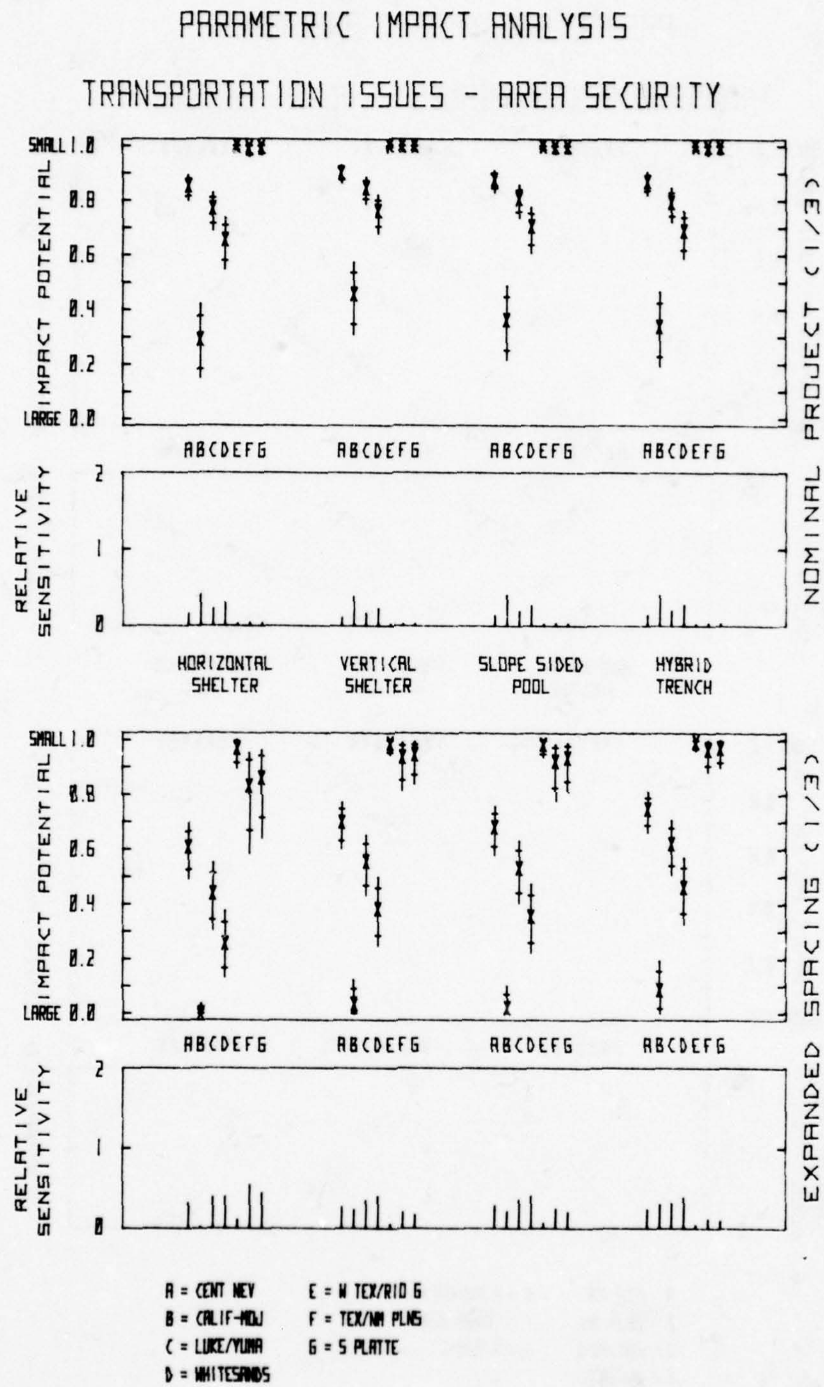


Figure A-58.


PARAMETRIC IMPACT ANALYSIS
TRANSPORTATION ISSUES - AREA SECURITY
SMALL 1.0
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0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-59.

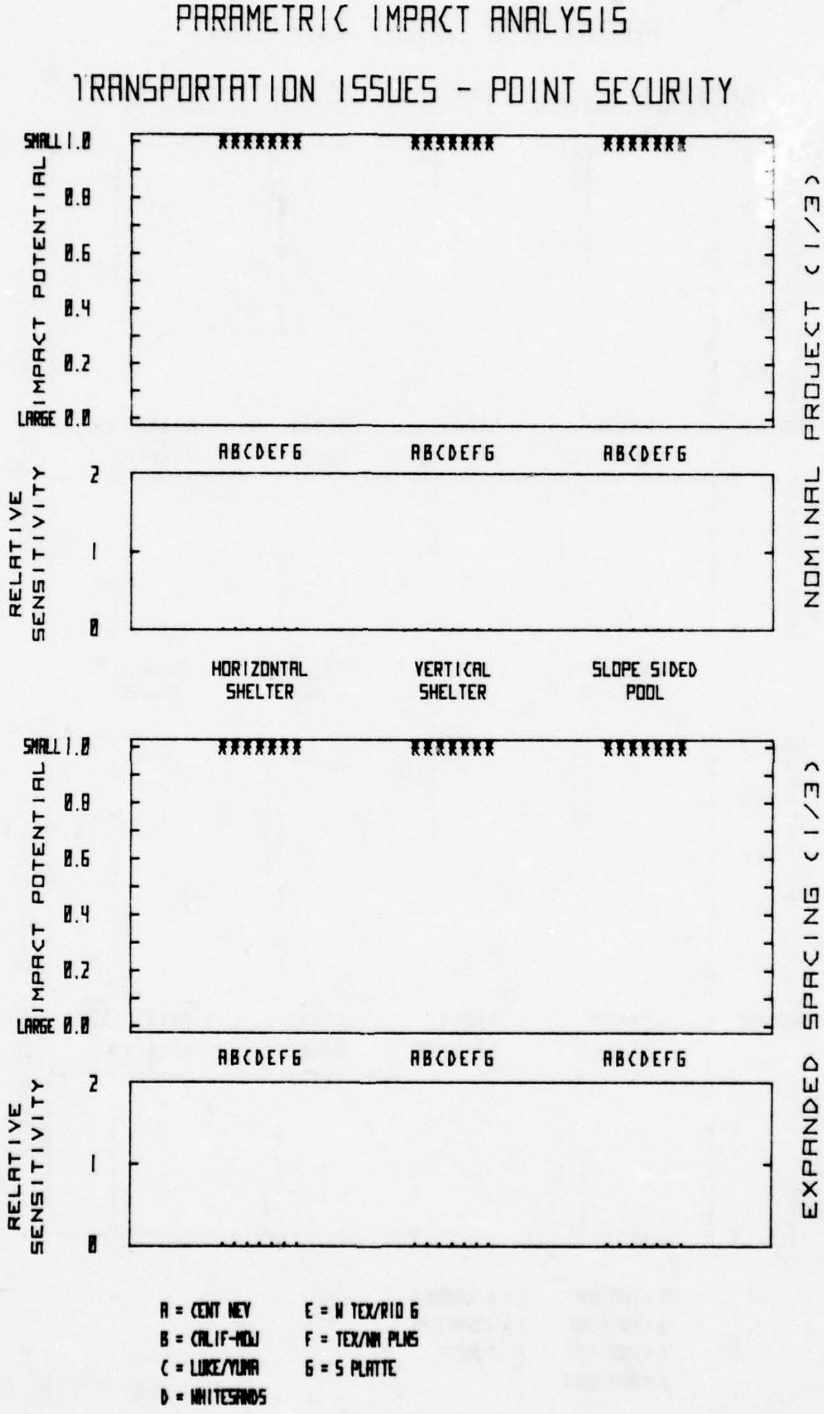
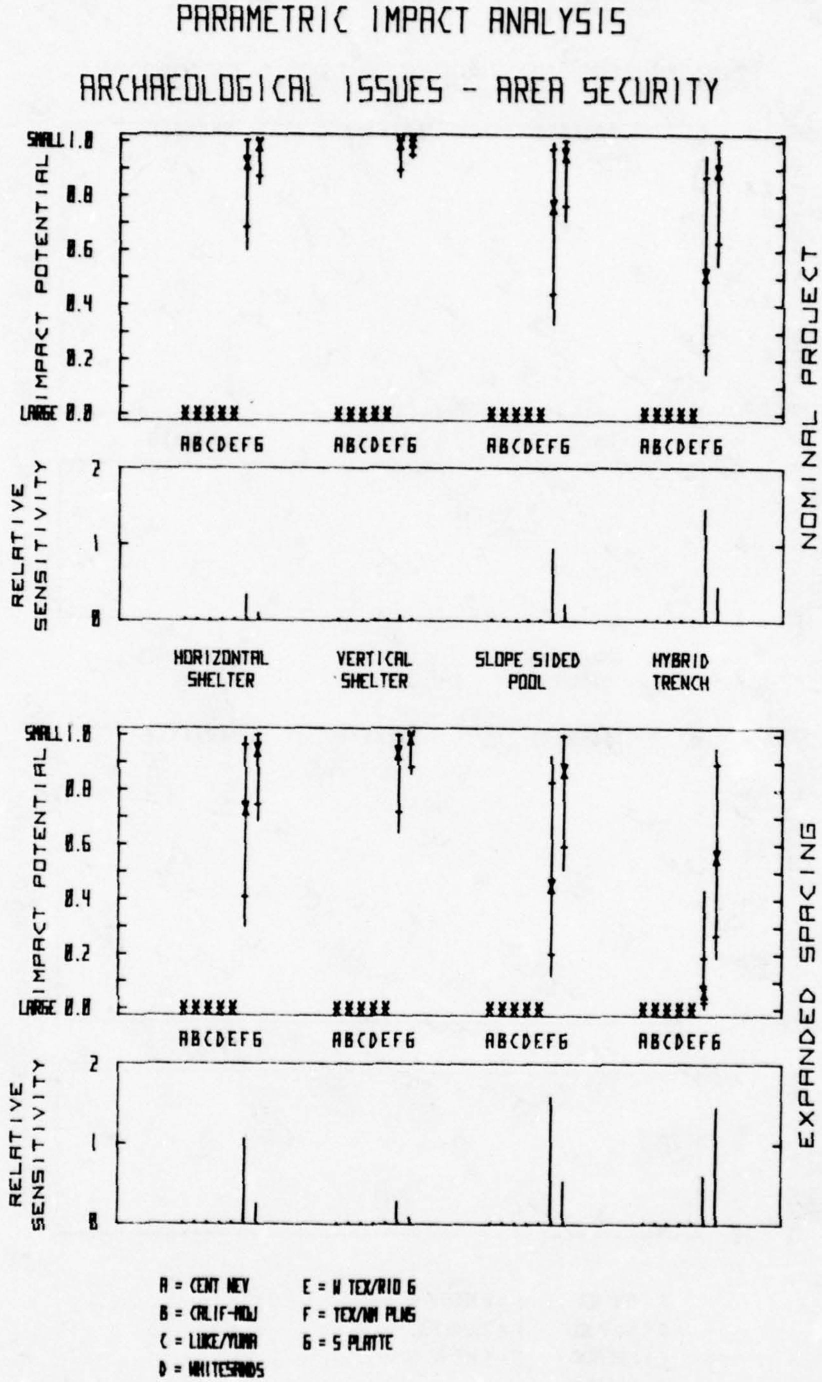
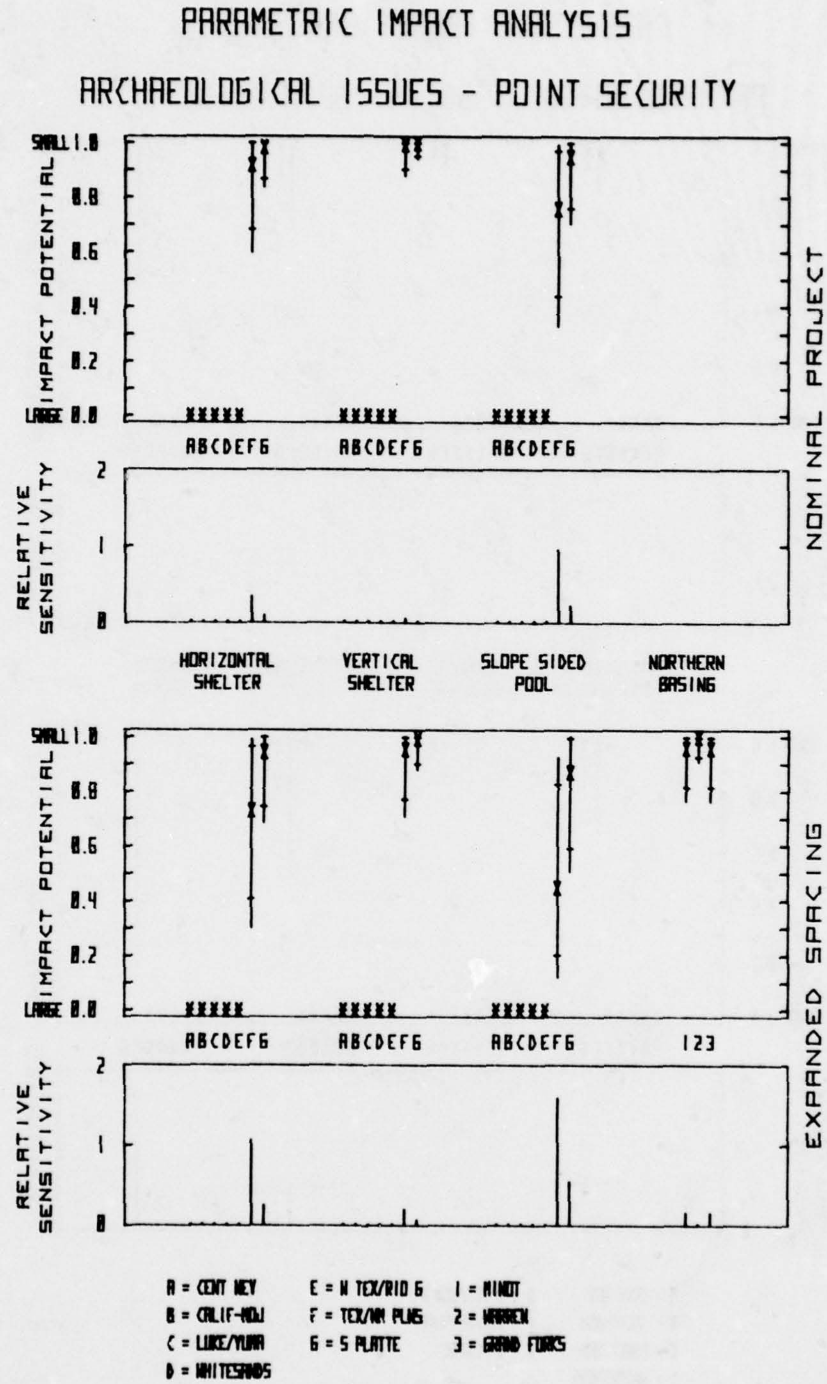

PARAMETRIC IMPACT ANALYSIS
TRANSPORTATION ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-60.



PARAMETRIC IMPACT ANALYSIS
ARCHAEOLOGICAL ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-61.


PARAMETRIC IMPACT ANALYSIS
ARCHAEOLOGICAL ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
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0.6
0.4
0.2
LARGE 0.0
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-62.

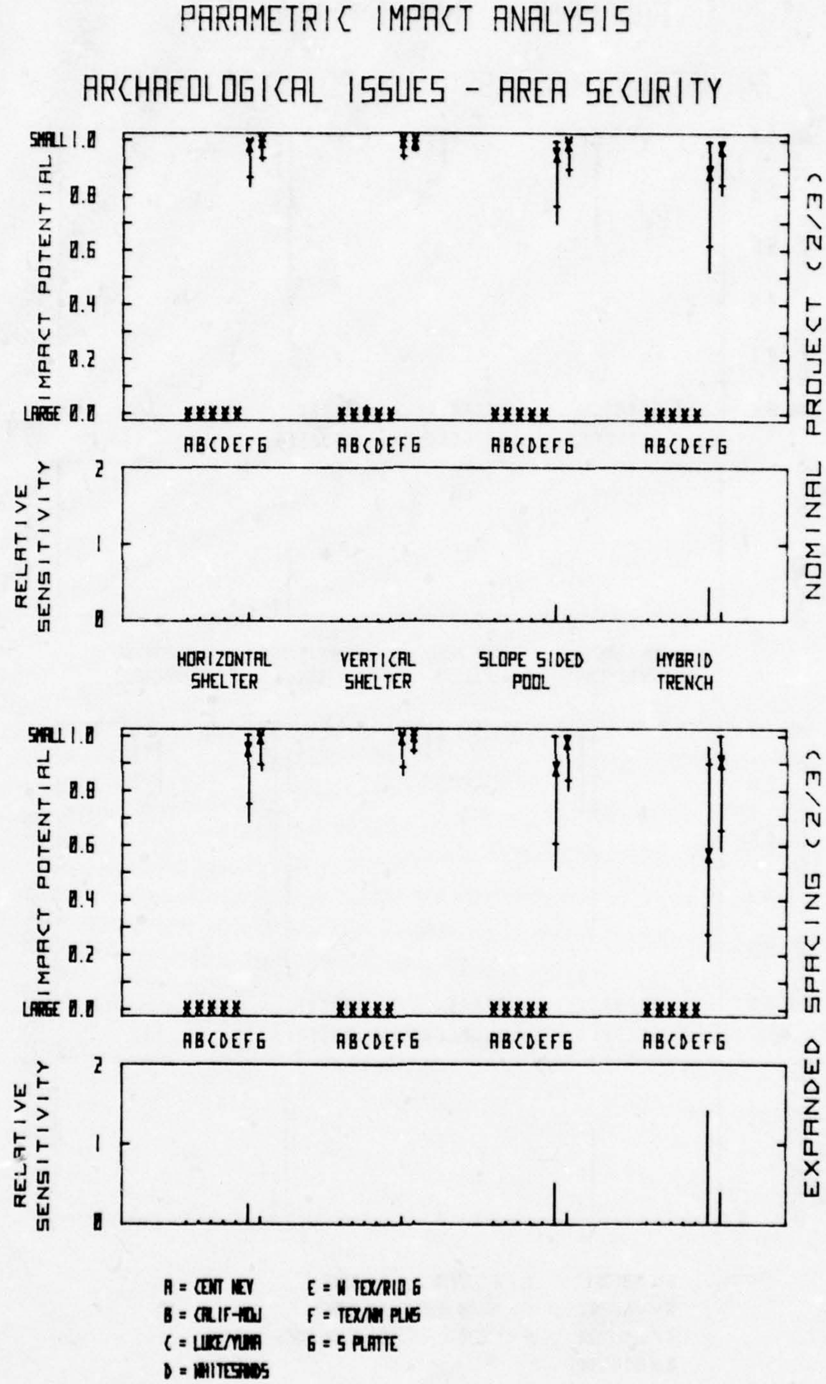

PARAMETRIC IMPACT ANALYSIS
ARCHAEOLOGICAL ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-63.

PARAMETRIC IMPACT ANALYSIS

ARCHAEOLOGICAL ISSUES - POINT SECURITY

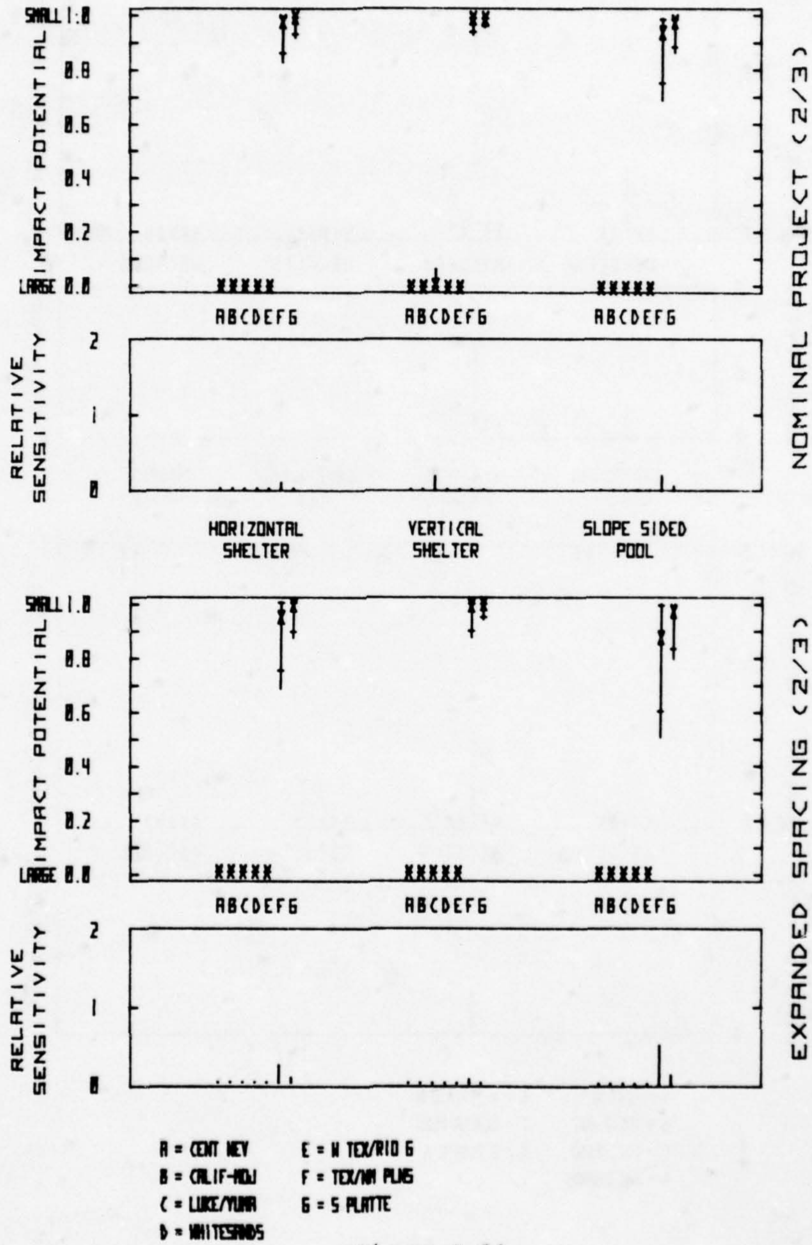
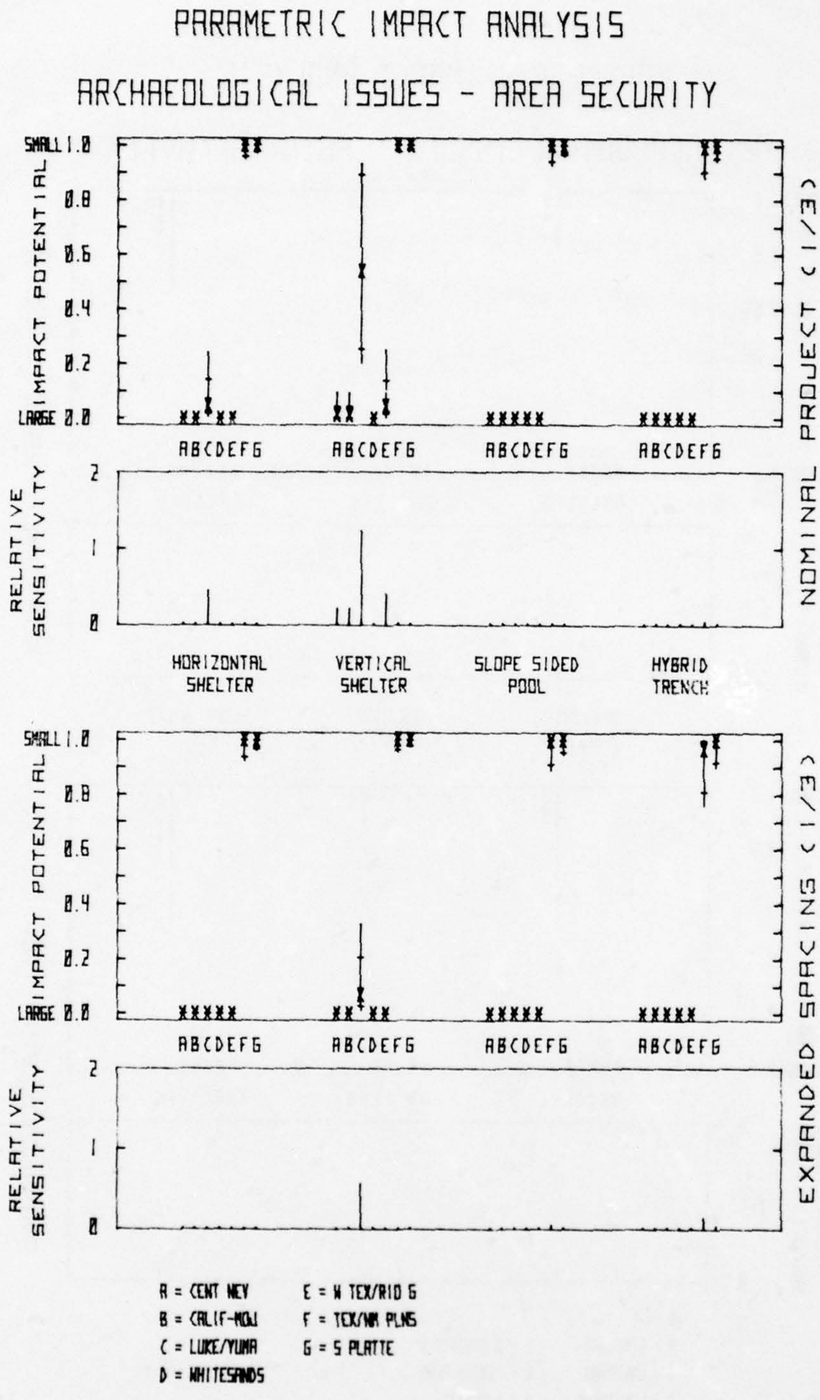


Figure A-64.


PARAMETRIC IMPACT ANALYSIS
ARCHAEOLOGICAL ISSUES - AREA SECURITY
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0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-65.

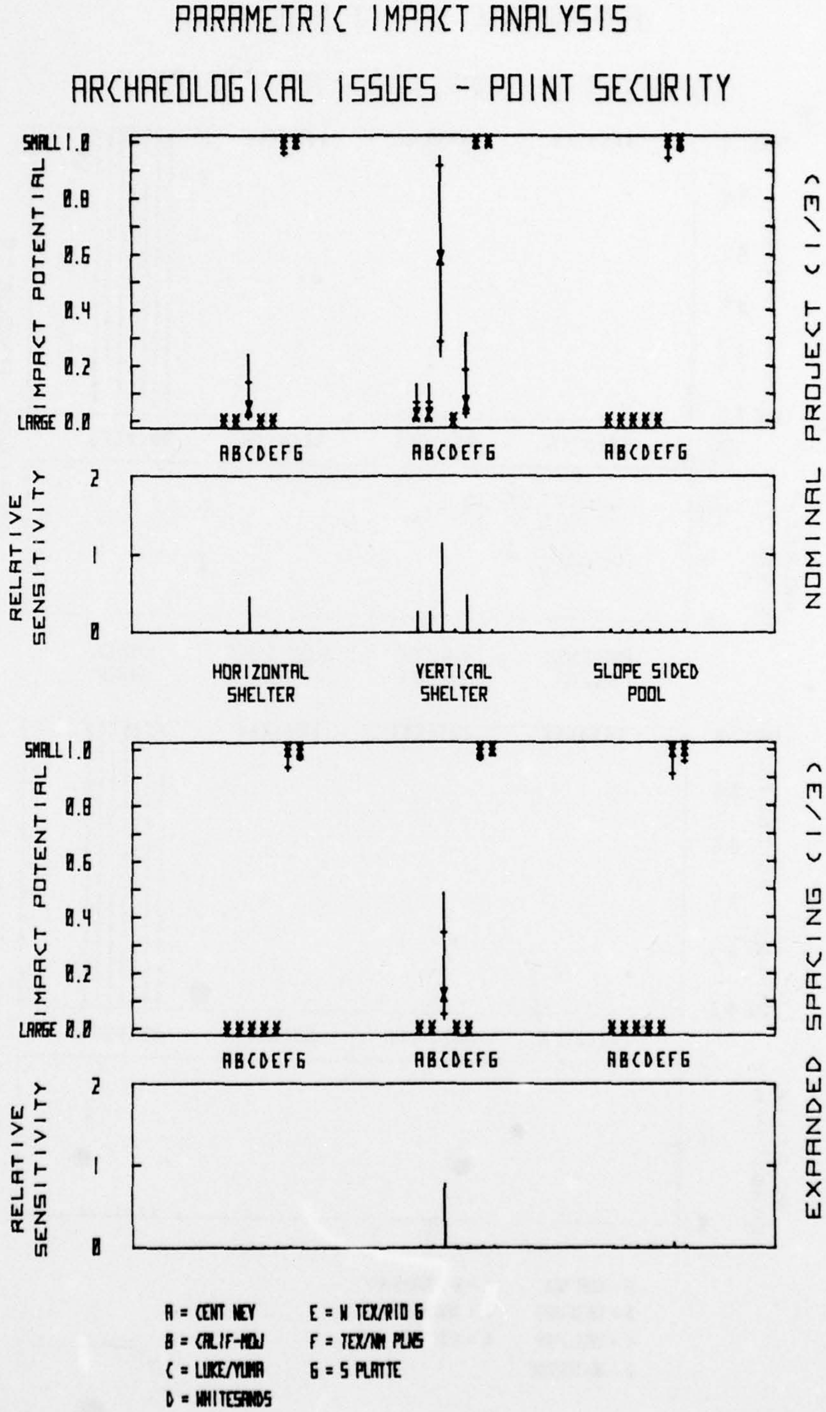

PARAMETRIC IMPACT ANALYSIS
ARCHAEOLOGICAL ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-66.

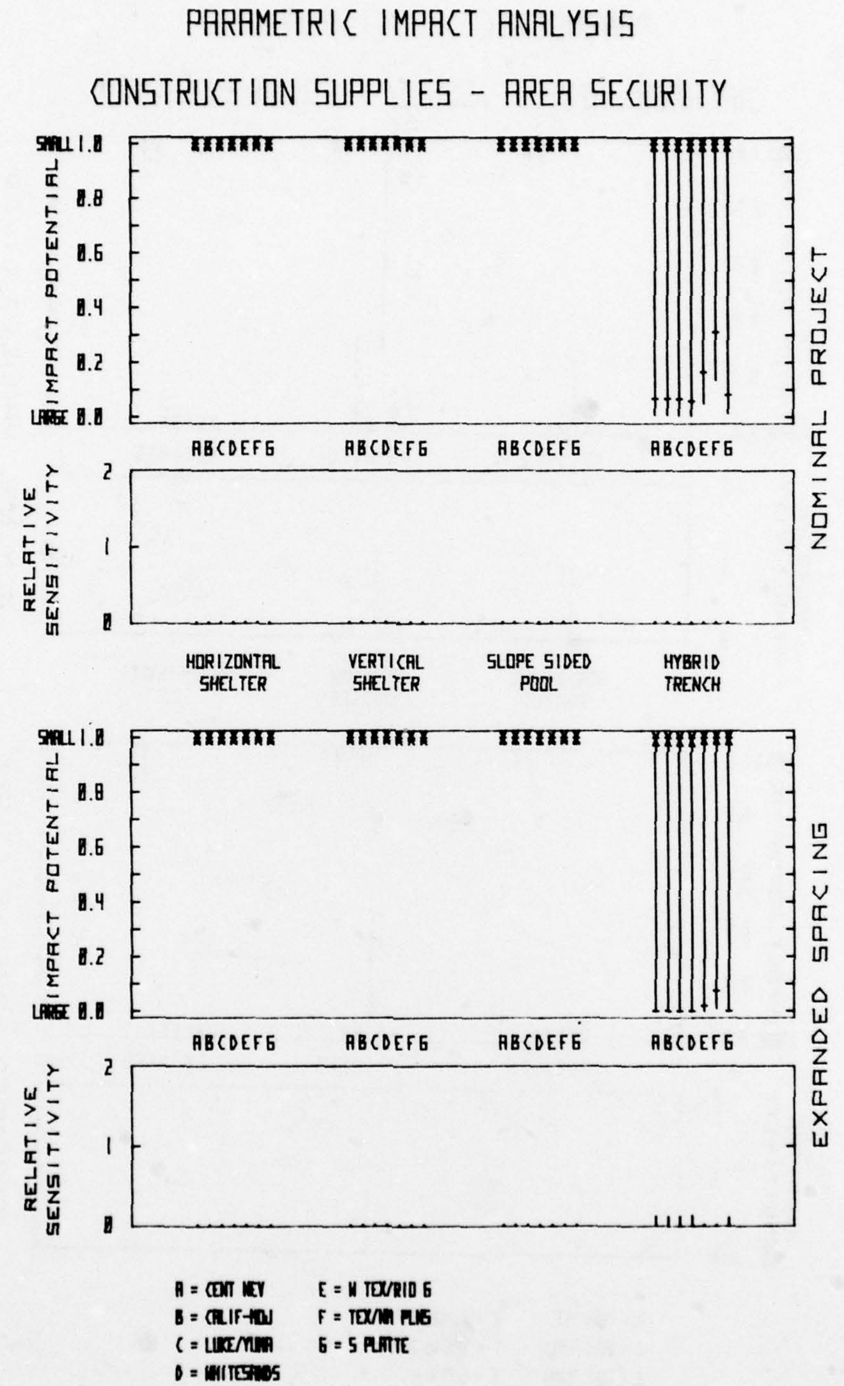

PARAMETRIC IMPACT ANALYSIS
CONSTRUCTION SUPPLIES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-67.

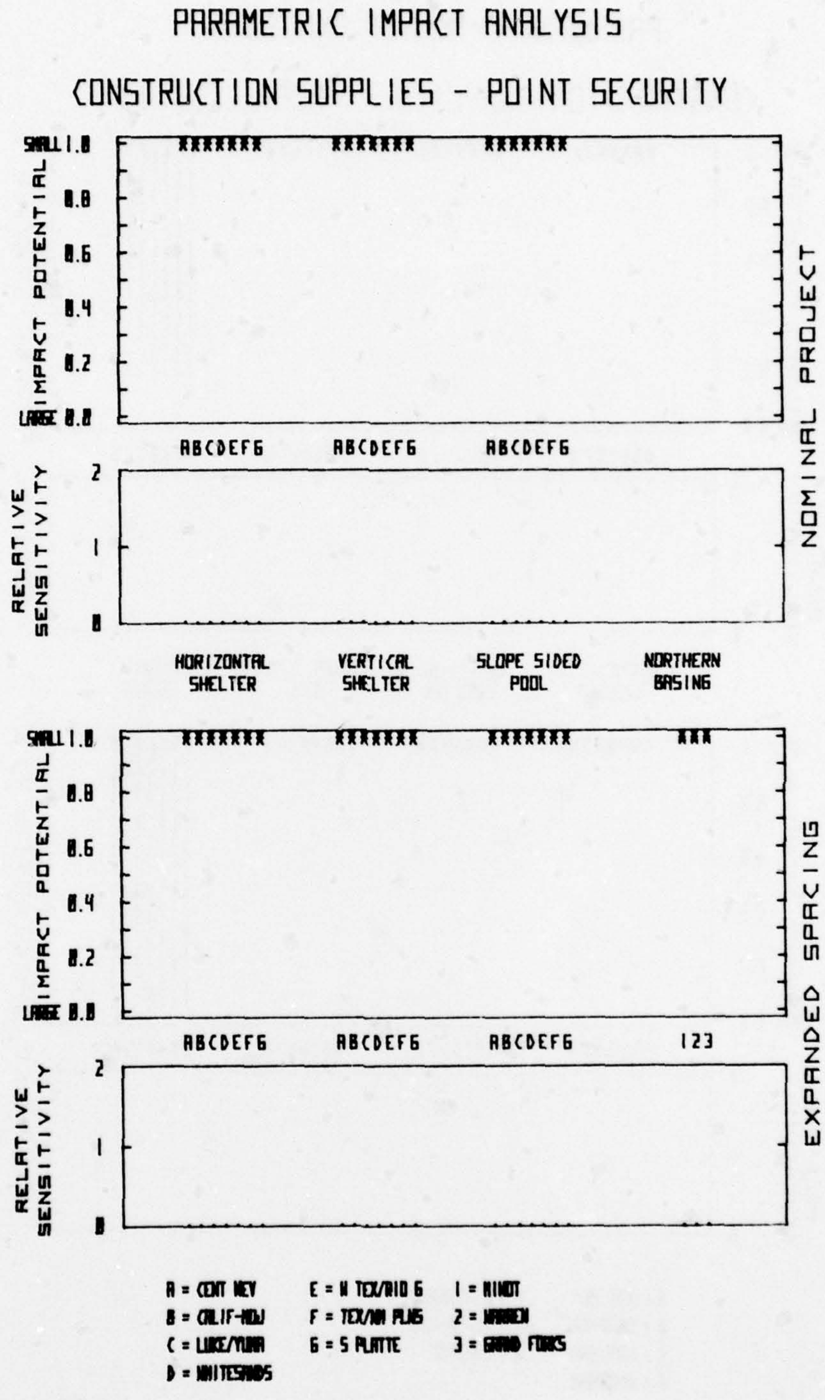
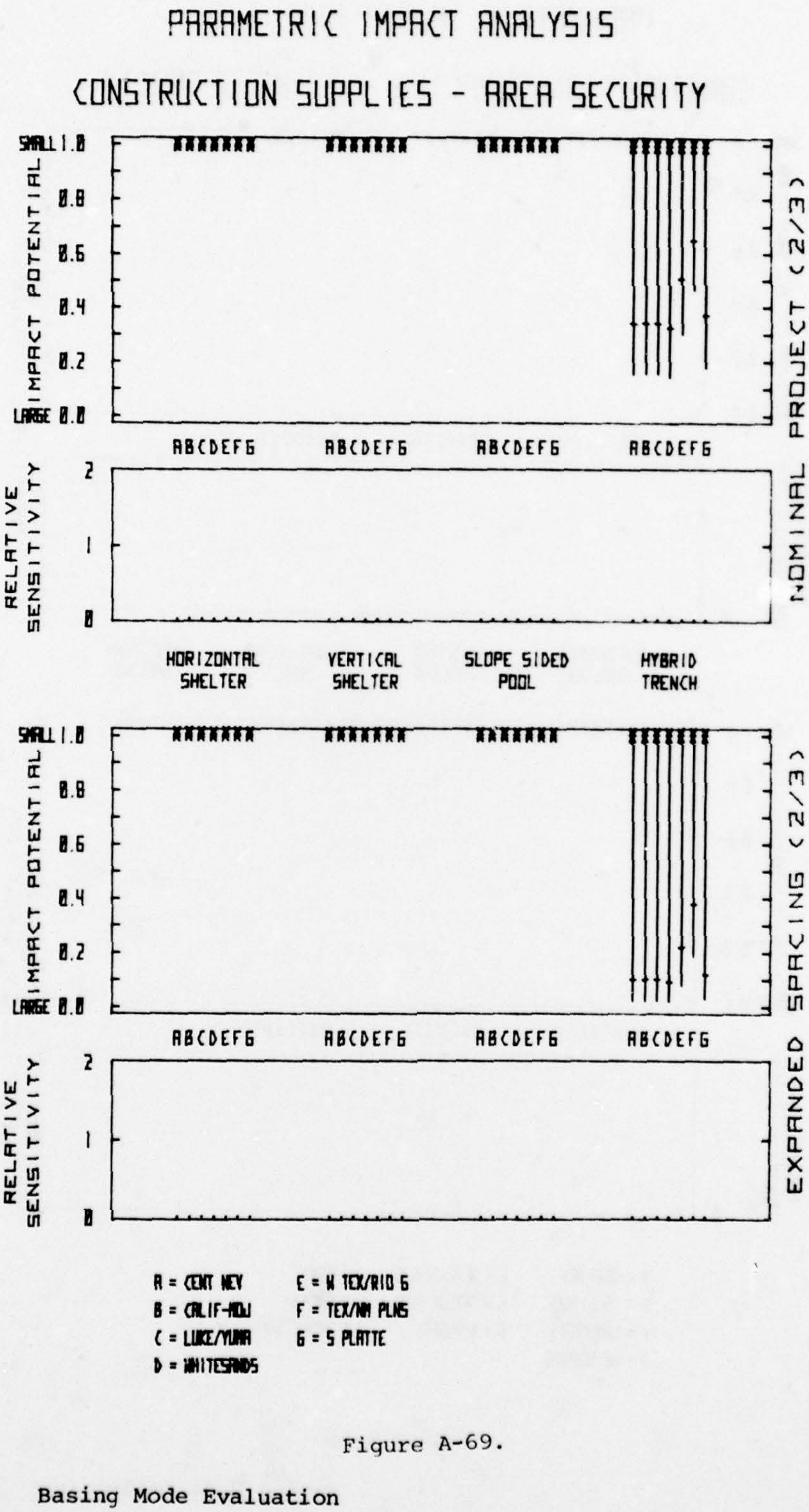

PARAMETRIC IMPACT ANALYSIS
CONSTRUCTION SUPPLIES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-68.



PARAMETRIC IMPACT ANALYSIS
CONSTRUCTION SUPPLIES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NOV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-69.

PARAMETRIC IMPACT ANALYSIS

CONSTRUCTION SUPPLIES - POINT SECURITY

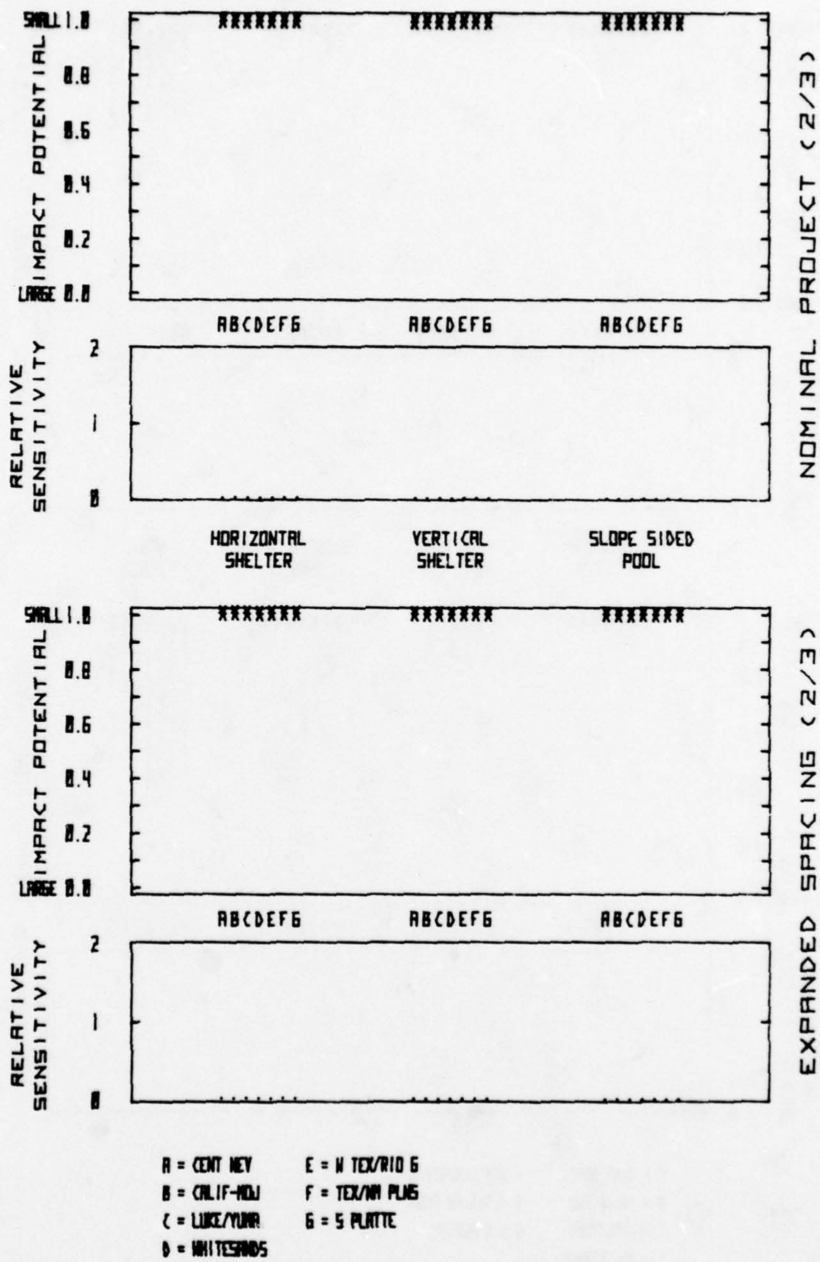


Figure A-70.

PARAMETRIC IMPACT ANALYSIS

CONSTRUCTION ISSUES - AREA SECURITY

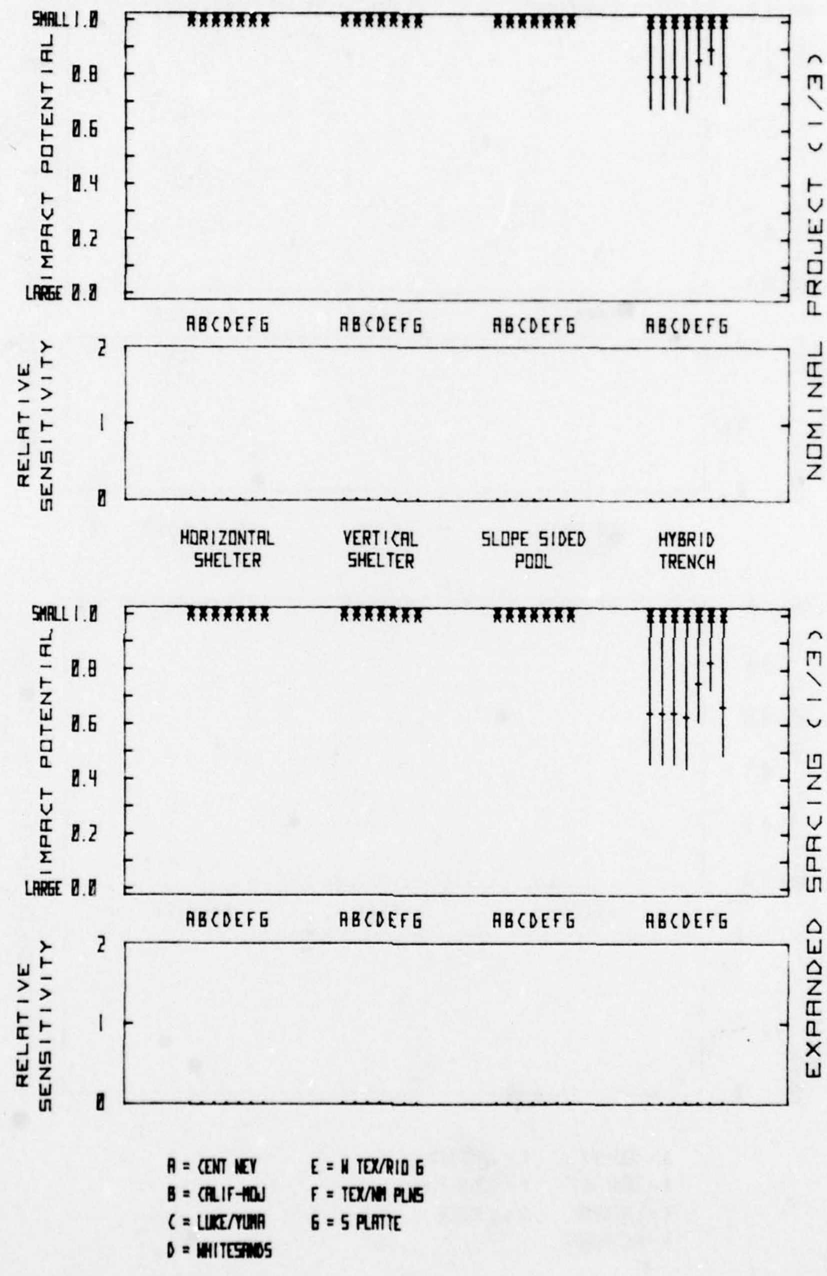


Figure A-71.

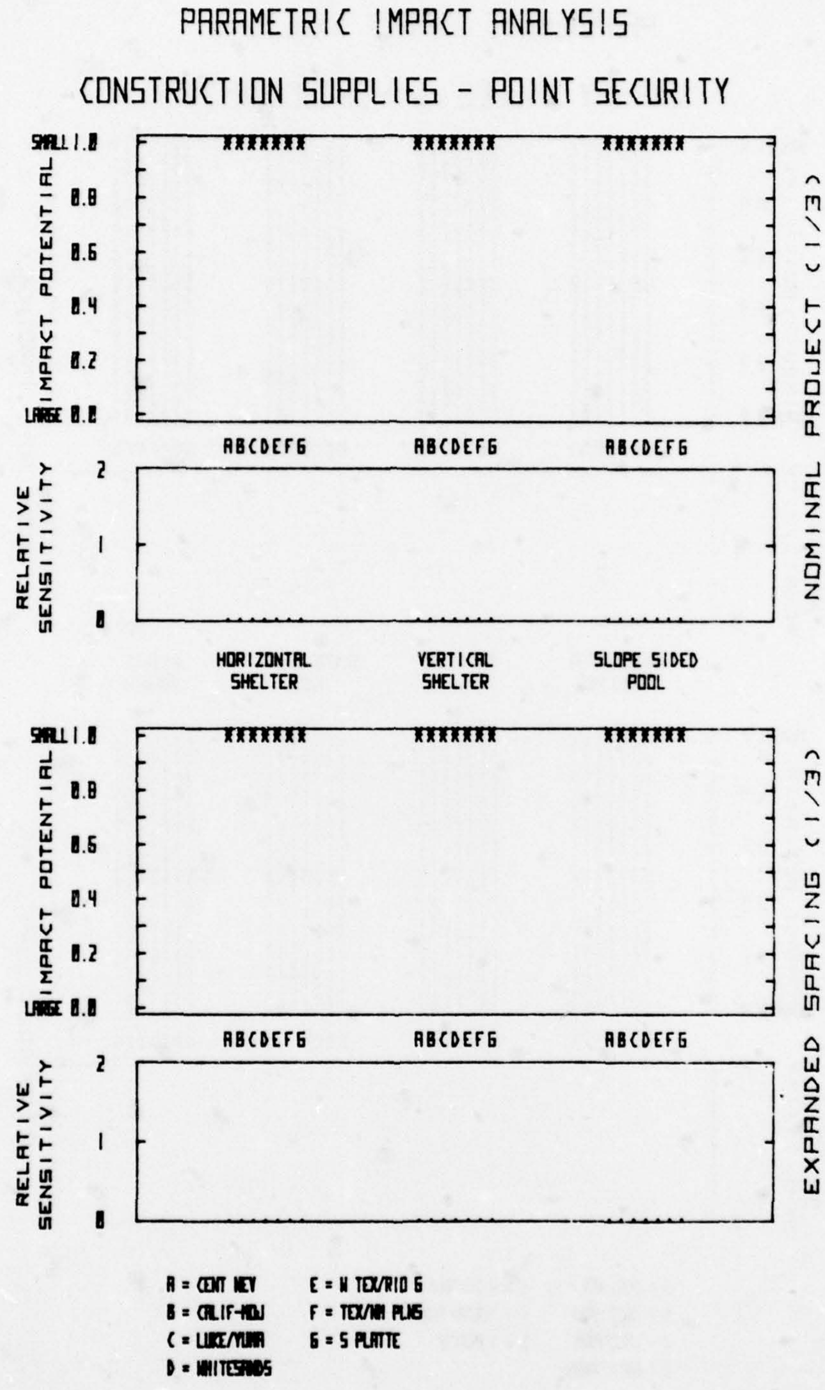
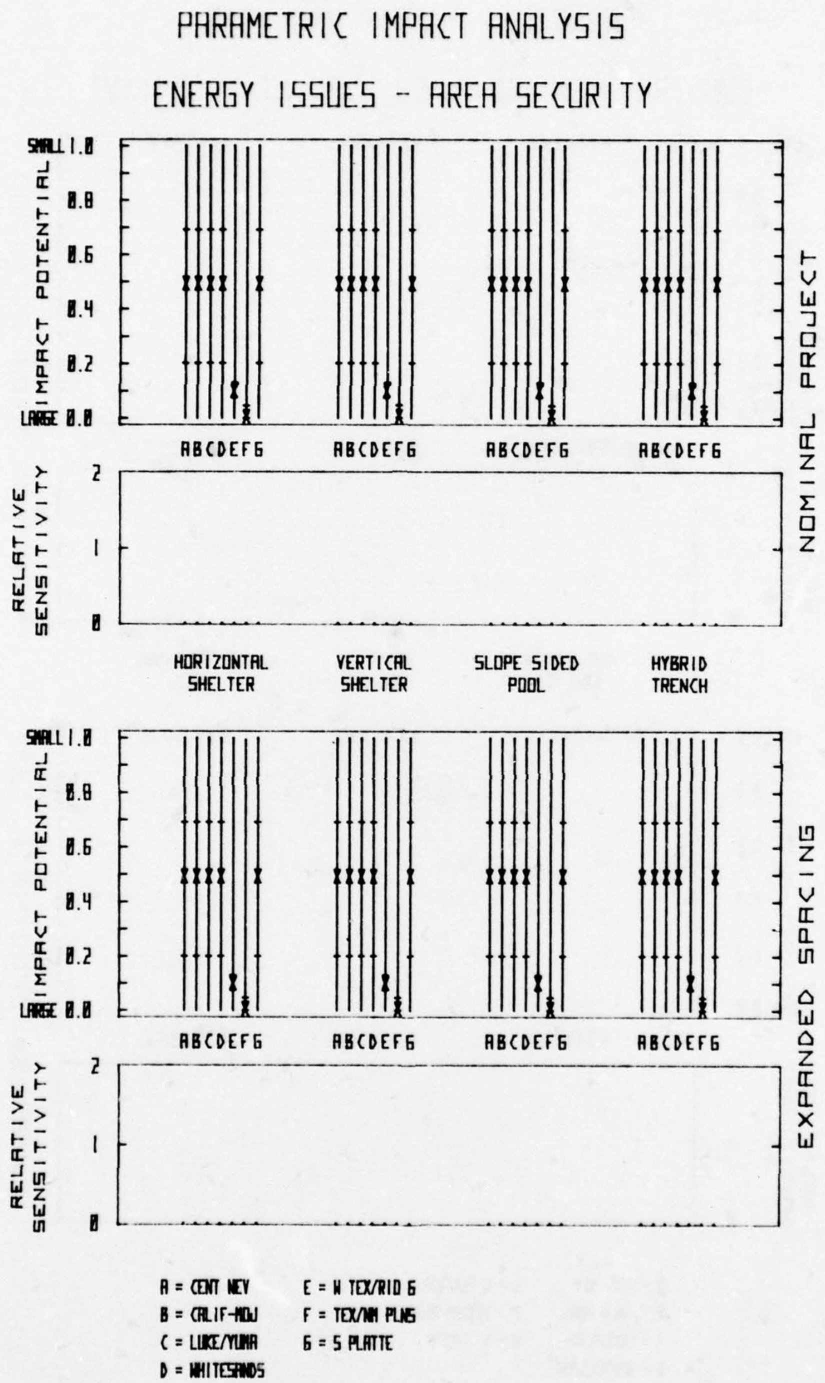

PARAMETRIC IMPACT ANALYSIS
CONSTRUCTION SUPPLIES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-72.



PARAMETRIC IMPACT ANALYSIS
ENERGY ISSUES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT
EXPANDED SPACING
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RID G
F = TEX/NM PLNS
G = S PLATTE

Figure A-73.

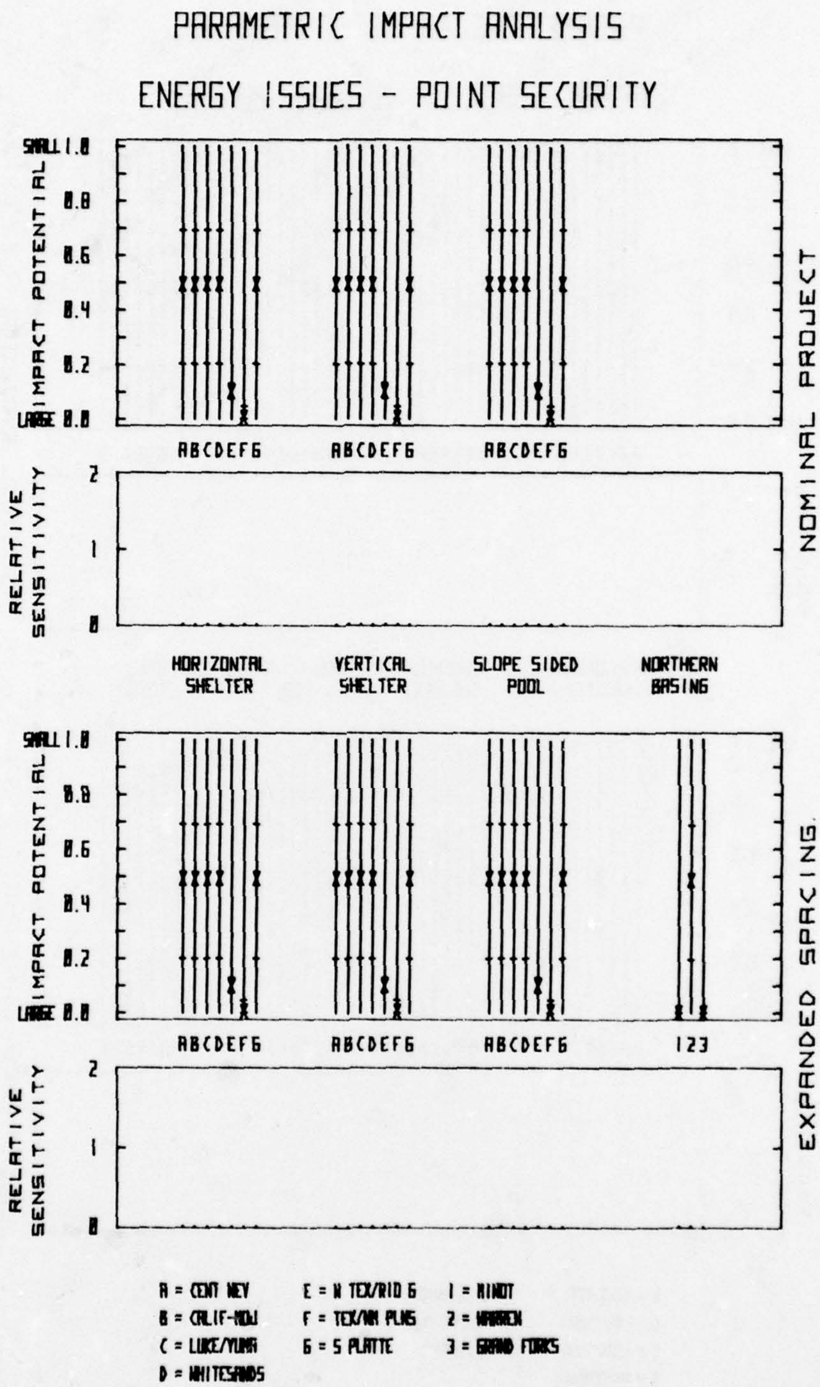
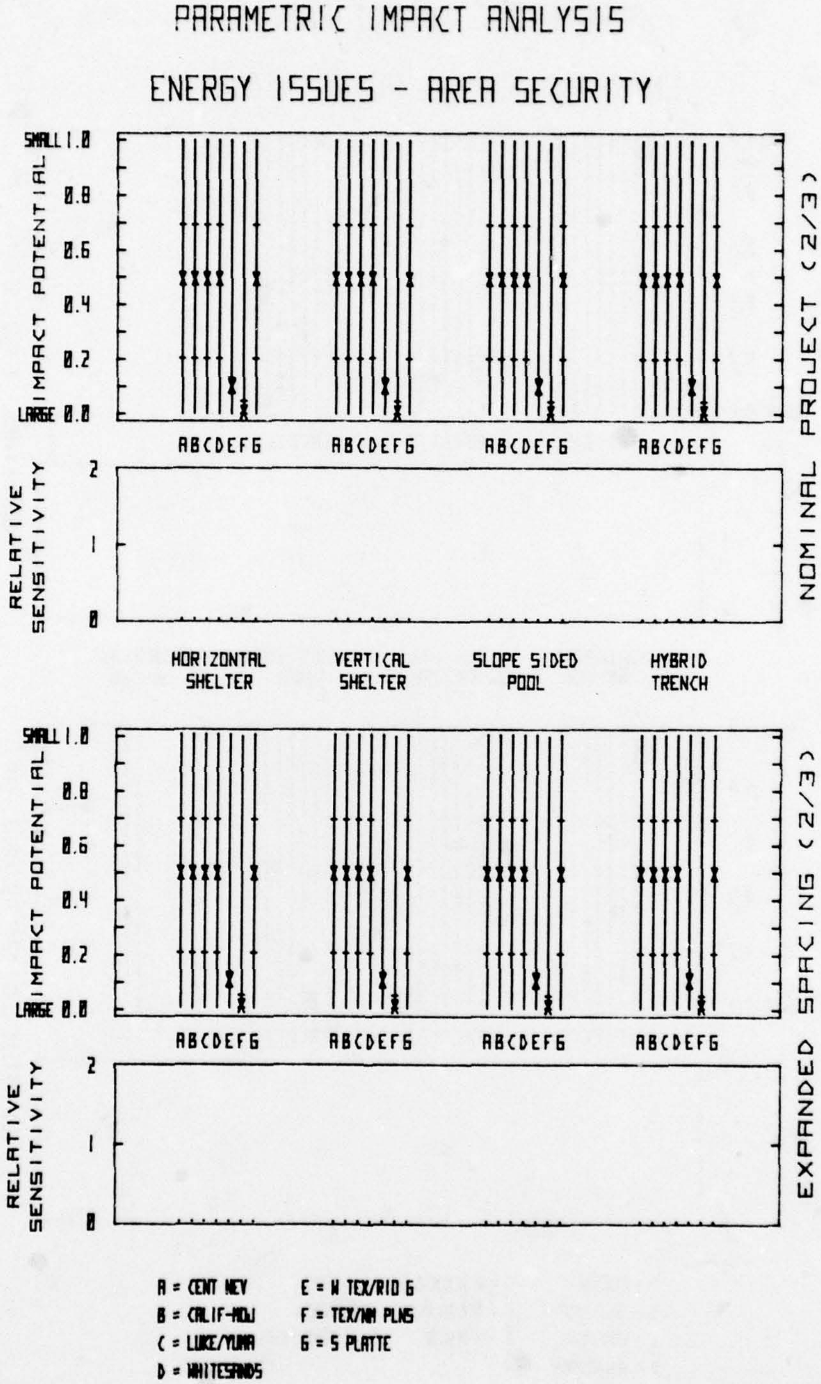

PARAMETRIC IMPACT ANALYSIS
ENERGY ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NORTHERN BASING
123
EXPANDED SPACING
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE
1 = MINOT
2 = WARREN
3 = GRAND FORKS

Figure A-74.



PARAMETRIC IMPACT ANALYSIS
ENERGY ISSUES - AREA SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
NOMINAL PROJECT (2/3)
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-75.

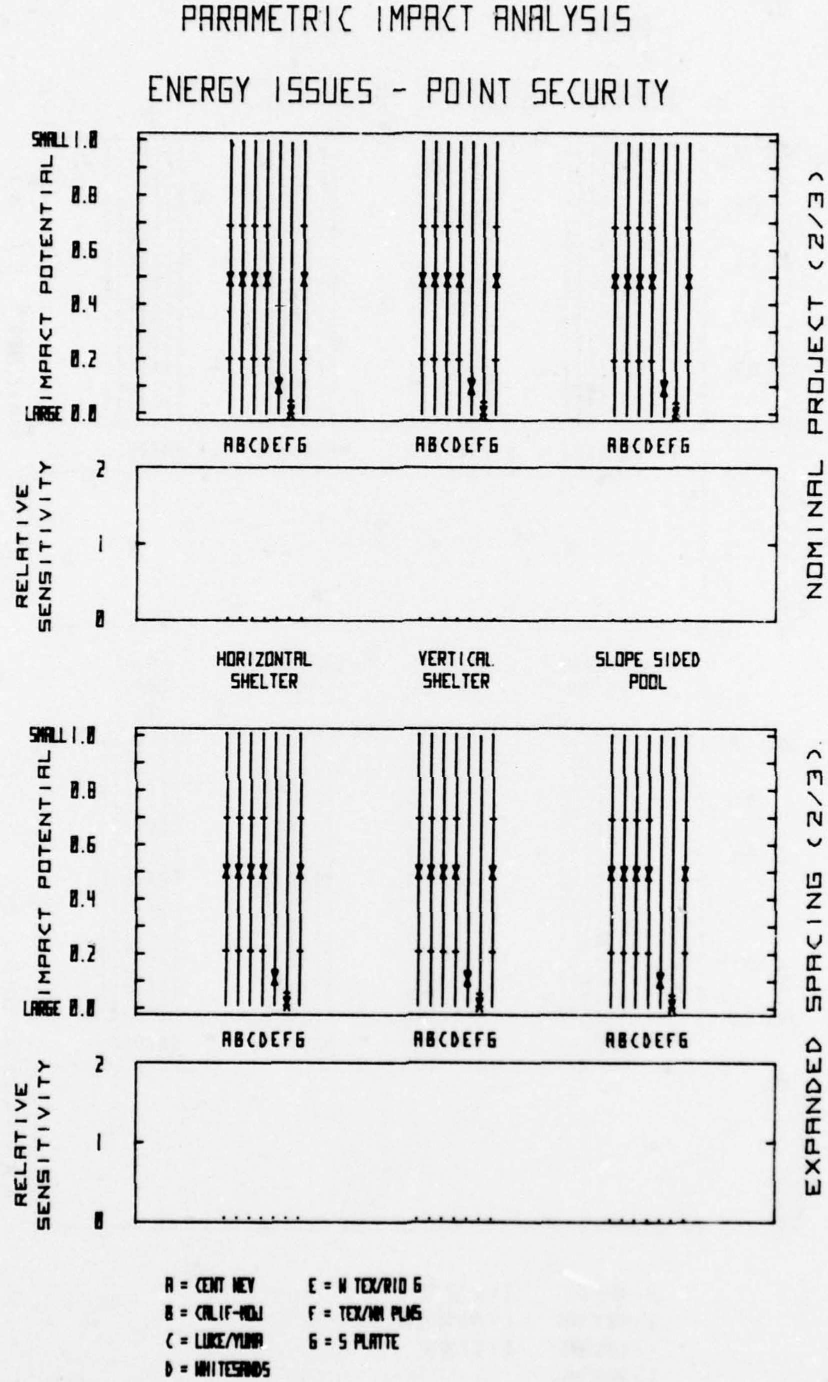

PARAMETRIC IMPACT ANALYSIS
ENERGY ISSUES - POINT SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
ABCDEFG
ABCDEFG
2
1
0
RELATIVE SENSITIVITY
NOMINAL PROJECT (2/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
EXPANDED SPACING (2/3)
A = CENT NEV
B = CALIF-NEV
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-76.

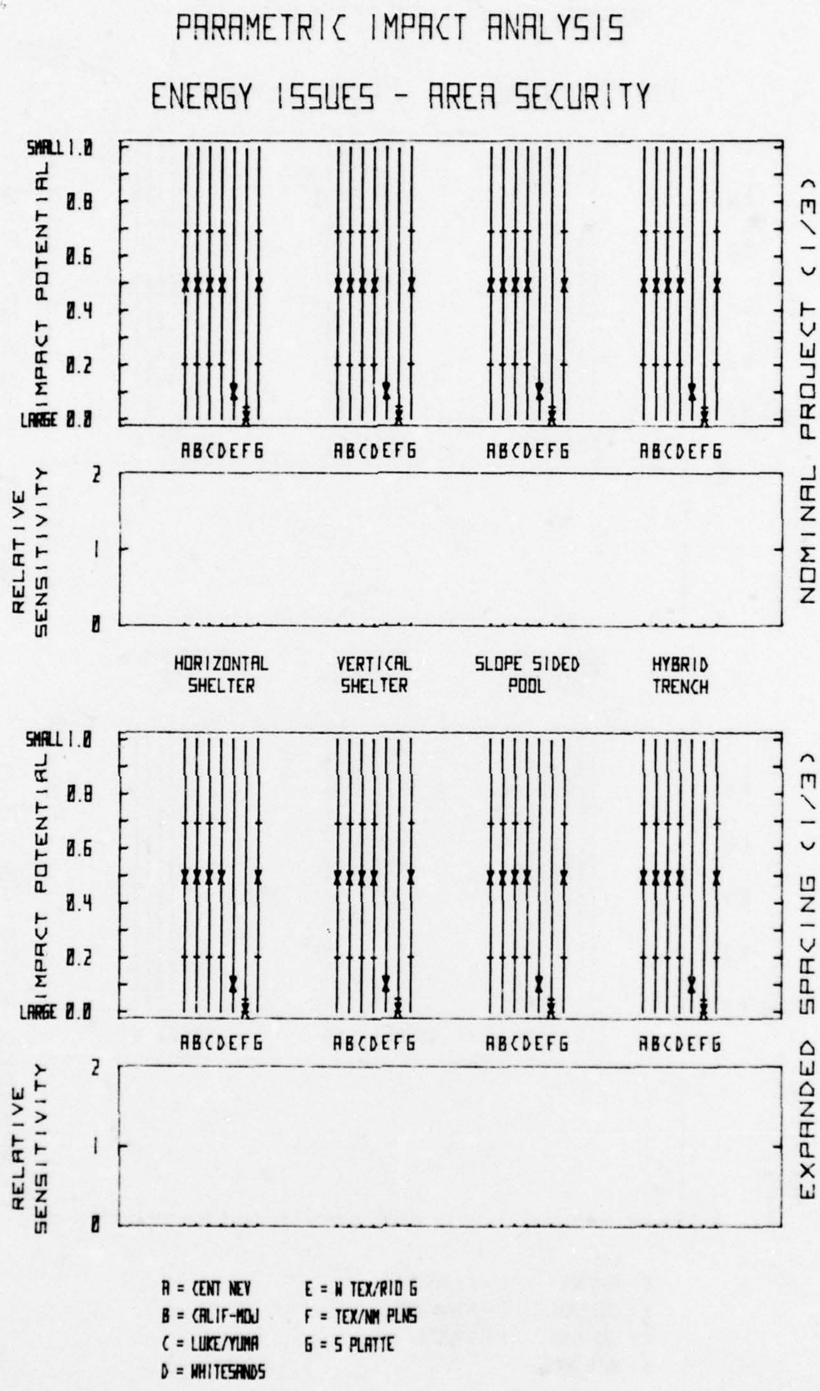

PARAMETRIC IMPACT ANALYSIS
ENERGY ISSUES - AREA SECURITY
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
IMPACT POTENTIAL
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
NOMINAL PROJECT (1/3)
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
HYBRID TRENCH
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-MOJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-77.

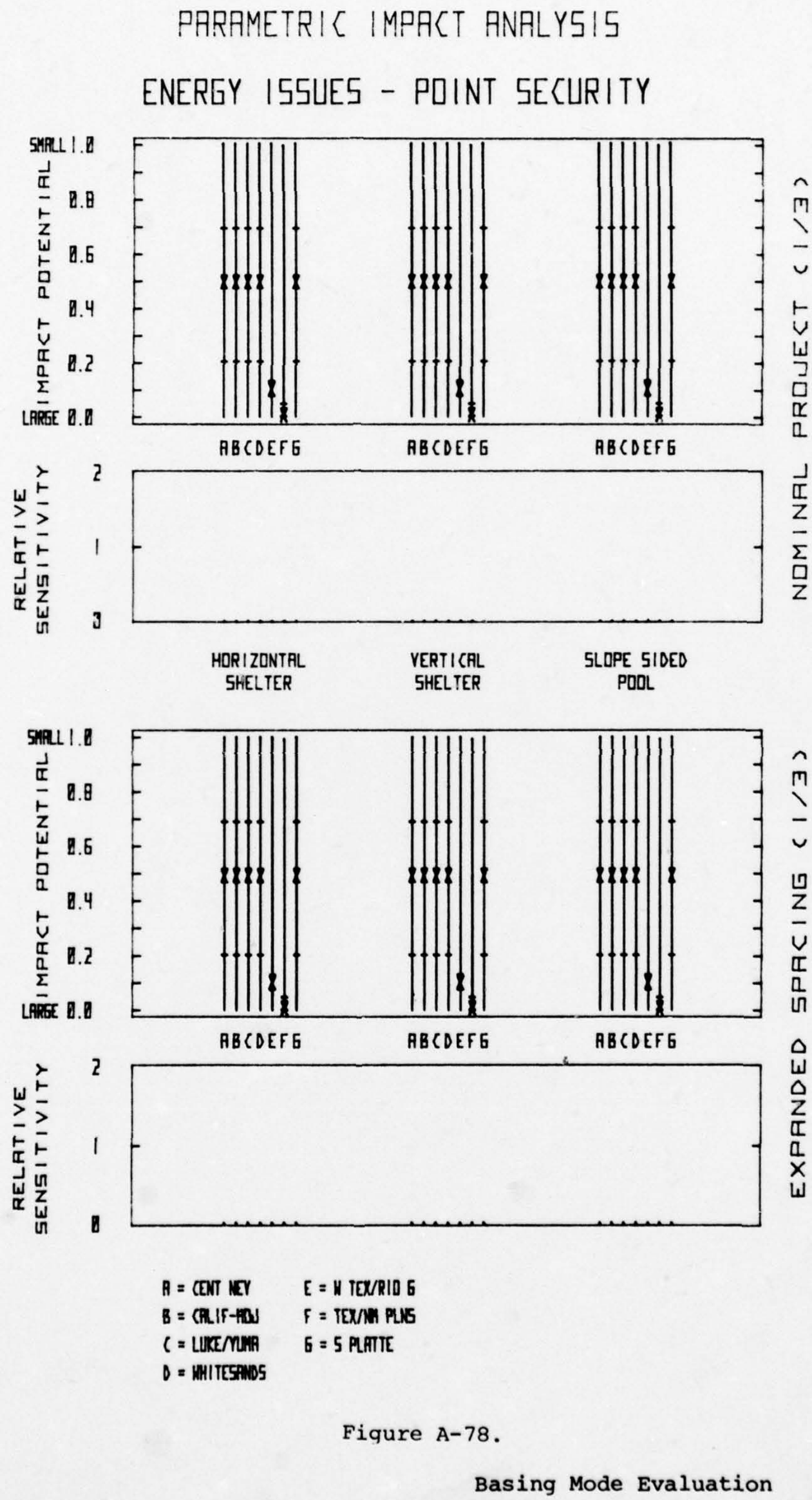

PARAMETRIC IMPACT ANALYSIS
ENERGY ISSUES - POINT SECURITY
IMPACT POTENTIAL
SMALL 1.0
0.8
0.6
0.4
0.2
LARGE 0.0
ABCDEFG
ABCDEFG
ABCDEFG
RELATIVE SENSITIVITY
2
1
0
HORIZONTAL SHELTER
VERTICAL SHELTER
SLOPE SIDED POOL
NOMINAL PROJECT (1/3)
EXPANDED SPACING (1/3)
A = CENT NEV
B = CALIF-ADJ
C = LUKE/YUMA
D = WHITESANDS
E = W TEX/RIO G
F = TEX/NM PLNS
G = S PLATTE

Figure A-78.